SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

April 1, 1996
NSRP 0506
N6-94-1

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

World Class U.S. Shipbuilding Standards

Task 2: The Management Plan

Part 3: Trip Report to IHI Shipyards in Tokyo, Nagoya and Kure, Japan

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
National Steel and Shipbuilding Company
San Diego, California

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 APR 1996	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program, World Class U.S. Shipbuilding Standards Task 2: The Management Plan Part 3: Trip Report to IHI Shipyards in Tokyo, Nagoya and Kure, Japan	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230-Design Integration Tower Bldg 192, Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5000**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**72**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

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CDI MARINE COMPANY
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April 17, 1996

Hideaki KOBAYASHI
Senior Technical Advisor
IHI Co., Ltd.
Tokyo-Chuo Bldg
6-2, Marunouchi 1-chome
Chiyoda-Ku, Tokyo 100 Japan

Dear KOBAYASHI san,

Enclosed is our final Trip Report report, (incorporating IHI's comments), of our visit with your shipyard. This report replaces your copy of the Draft Trip Report. The discussions and information which you provided on your World Class Shipbuilding Standards development and management program was constructive and informative.

Again, on behalf of all team members, I wish to thank you and all of the people at IHI for your quality time and thorough coverage of the questions that we asked. Your hospitality was appreciated very much.

All of the team members look forward to seeing you, should opportunity present itself, at future functions involving the World Shipbuilding Community.

Sincerely,

Devens D. Arnett
Director of Engineering

TRIP REPORT

NSRP STANDARDS TEAM VISIT

TO

IHI SHIPYARDS

TOKYO, NAGOYA AND KURE, JAPAN

NOVEMBER 27-30, 1995

CONTENTS

22 December, 1995
Revised 22 March,1996

TRIP REPORT

Subj Trip Report, NSRP Standards Team Visit to Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) Shipbuilding Division, New Construction Shipyards, Tokyo, Nagoya and Kure, Japan - 11/27-30/95

Encl (1) IHI Co., Ltd. - Trip Notes
(2) Aerial Photo of IHI's Tokyo, Aichi and Kure Shipyards, Shipyard Layouts and Organization Charts
(3) IHI Computer Systems Map (Systems Structure/Flow Chart) for Shipbuilding and AJISAI Design CAD System Flow Chart
(4) NSRP SP6 Project 6-94-1, World Class Shipbuilding Standards, Questions and Response from IHI's New Construction Shipyards, Tokyo, Nagoya and Kure, Japan - dtd 12/22/95

Traveled to Tokyo, Japan on 25-26 November, 1995, to meet with other United States Shipbuilders' representatives to visit with Ishikawajima-Harima Heavy Industries Co., Ltd. Shipbuilding Division, (IHI), and Sumitomo Heavy Industries, Ltd., Shipbuilding Division, (SHI), to learn about their development and application of standards to the commercial shipbuilding process.

Team Members:

Phil Lloyd	NASSCO
Walter Devine	NASSCO
Bobby Joe Griffin	Avondale Shipyard
Laddie Matherne	McDermott Shipbuilders
Raephael Cronin	NNS
Devens Arnett	CDI Marine Co

The Team has endeavored to present the highlights of what we learned at IHI in this trip report summary. Enclosures (1) through (4) provide further details.

<u>About IHI Shipyards and IHI Co., Ltd.</u>
IHI's new construction shipyards are located in Tokyo, Aichi and Kure. They also have two overhaul and repair shipyards located in Aioi and Yokahama. A profile of IHI's history and an IHI organization chart are provided in enclosure (2) along with aerial photographs and shipyard layout graphics of the three new construction shipyards.

IHI contracts all naval ship design and construction in their Tokyo yard. Standards for Japanese Navy ships are similar to US Navy Mil-Stds. Commercial work is conducted at Aichi and Kure shipyards with all engineering after basic design dome in house at the particular shipyard.

IHI's origin goes back to 1853 with the founding of the Ishikawajima Shipyard. Over the years, IHI has expanded through mergers and new acquisitions and enterprises into a major company having over 16,000 employees. IHI of today, is a multifaceted heavy industry producing products and services in electric power, chemical and steel making plants, industrial machinery, cargo handling equipment, transportation systems, civil engineering/construction machinery, ships and ocean structures, space machinery, space rockets, jet engines and etc..

IHI is exporting products and services to over 100 countries, has 30 domestic sales offices in Japan and 11 overseas offices, has 13 companies incorporated abroad and is participating in 14 foreign joint ventures.

IHI's shipbuilding peaked 25 years ago, at a world market share of 9.4%, dropping to 7.4% by 1976 and currently at 4%. In 1974, IHI constructed vessels totaling ~2.5 million tons. 15 years ago, 16,000 people were employed in IHI shipbuilding and repair; many people have subsequently been transferred to other IHI industries. There may be further reductions in force by concentrating the big size commercial shipbuilding capacity at Kure Shipyard, to be more cost competetive. IHI's Aichi Works is to change their manufacturing field from ship to land use equipment next year; ~600 people, (100 from design), will be transferred to Tokyo or Kure shipyards or to other IHI divisions. IHI will focus on the continued development of the Kure and Tokyo shipyards. Refer to Attachments (1) and (2) [to Enclosure (4) Q & A Matrix], for details of vessels, tonnage and work force.

Discussion

IHI's Senior Management provided quality time to review IHI's profile and respond to our questions as well as arranging for many of the shipbuilding divisions' shipyard managers, from design and production areas, to participate in the discussions. The principal participants were:

IHI Headquarters
Mr. Hideaki Kobayashi, Senior Technical Advisor
Mr. Akito Shida, Manager, Strategic Planning Group
IHI Tokyo Shipyard
Mr. Yasushi Jogo, Naval Architect, Project Coordination Department
Mr. Norio Hata, Project Leader (AJISAI, CALS), Naval Architect
Mr. Yuzo Yamada, Manager, Engineering Administration Group

Mr. Haruo Takeda, Manager Of, Engineering Administration Group
Mr. Ichiro Ogura, Manager Of, Quality Assurance Group
Mr. Seikoh Igarashi, Manager, Quality Assurance Department
Mr. Kazutoshi Yamamoto, Senior Manager, Sales and Marketing Headquarters

Aichi Shipyard

Mr. Hiromu Ito, Manager, Aichi Engineering Department
Mr. Noritaka Uesugi, Systems Engineer, Computer Systems Group
Mr. Takashi Ueno, Manager, Electric and Control Group
Mr. Kazumi Morimoto, Computer System Group
Mr. Etsuo Takagi, Computer System Group
Mr. Kiyoji Uo, Computer System Group

Kure Shipyard

Mr. Taku Ito, Sales Business Department
Mr. Hidehiko Kashima, Manager, Production Control Department
Mr. Masataka Kakimoto, Manager, Staff Group

ABS Pacific

Mr. Ken Okabayashi, Manager-Japan
Mr. James B. Liebertz, Vice President, Northern Region
Mr. Merhi Unuvar, Principal Surveyor, Special Projects

IHI's Standards were established a long time ago and are well integrated with their design and manufacturing processes. The number and types of standards are tabulated in Attachment (A). All IHI standards are maintained by the people that use them.

15 years ago, IHI moved from a single Standards Group to multiple Standards Committees established throughout the technical disciplines and QA areas, in an effort to improve efficiencies and reduce manpower requirements. IHI believes their standards, which are managed in accordance with the principles of ISO 9001 and have minimum review cycles of 3 to 5 years, are World Class Quality.

Standards development/revision and review is accomplished within the discipline with approval authority by the discipline Committee Chairman, Department Chairman or cognizant Section Manager. Refer to Standards Approval Matrix, page 6 of enclosure (1) - Trip Notes.

Present standards exist in a paper base format, but are being incorporated in an electronic data base, integral with their CAD/CAM System, to the extent required to support a fully automated CAD/CAM process. Anticipated completion is August 1996.

IHI is in the process of developing CAD/CAM systems utilizing AJISAI software for Hull and Outfit design. Demonstrations of IHI's CAD capabilities for hull structure, electrical and piping design provided for a good understanding of the state of the development of the AJISAI H and F systems. The Hull CAD AJISAI H system was basically 100% complete with the Outfit CAD AJISAI F approximately 50% complete and projected to be complete for testing by March 1996. Following 5 months of testing, the Outfit CAD will be on line, 100% complete by August 1996.

CAM Production Control Shop Processes, utilizing "Klean System" software in a Microsoft Windows version 3.1 format, are on line for fabrication and assembly; erection schedules not on line as yet. System capabilities were demonstrated, (using PC graphics projected to screen), and handouts. Their production control system appeared to be very easily monitored, adjusted and maintained. Some highlights are:

- CAM Production Control system allows menu selection for any applicable schedule for major components/units. Each component/unit has a line schedule shown - multiple components/units shown on one screen.
- System shows components/units location for any given date; locates units on shipyard overlay by specific selection; selected block appears in red.
- Provides information as to what portion of an area/shop is able to do more work at any specific time and to what extent (%).
- Movement of components/units done automatically to match entered dates.
- 16-20 people cover entire shipyard for Production Control.
- Periods, man-hours, dates, etc., are established in a standards database for each unit/block, in a block master schedule. Monthly schedules are developed from the block master schedules.
- Foremen can change schedules as they reviews actuals. Block progress is checked daily.
- Total CAM Production Control System developed in 1 year by IHI personnel.
- System tracks man-hours for each worker against each unit or block. Net result is a very sophisticated production control system in Microsoft Windows.

Flow charts of the Shipbuilding Information Management System by Product Model and CAM Production Control System are shown in Attachment (B) [to Enclosure (1)].

<u>Summary</u>

IHI believes the shipbuilding market demand is expanding worldwide. IHI projects 20 million tons of new ship demand, with 10% for increased shipping capacity and

90% for vessel replacement. Further, IHI anticipates 30-40 VLCC's per year for the next 25 years - replacement and new pollution control requirements.

World market capacity and competition are forcing IHI to increase ship production efficiencies in an effort to remain competitive. Standards utilization at IHI is a vital ship production efficiency. They are very much second nature and integrated into all phases of the shipbuilding process. IHI's customers, generally, are well aware of the extent and quality of these standards and do not have this as a major concern when contracting for a new vessel or structure.

IHI is continuing to demonstrate high quality leadership in the area of world class shipbuilding standards maintenance and application. They are working hard to achieve the necessary full implementation of state of the art CAD/CAM Hull and Outfit systems in a highly competitive market. Awareness of the importance of standards and the development and maintenance of standards by the end user, clearly provide the basis for IHI's existing World Class Standards base. The incorporation of these standards into a CAD/CAM system, fully integrated with manufacturing, will ensure IHI's position in the World Class Shipbuilding Industry. IHI produces excellent, high quality vessels - on schedule and within budget.

ENCLOSURE (1)

- **IHI Trip Notes**

ISHIKAWAJIMA-HARIMA HEAVY INDUSTRIES Co., Ltd., TOKYO, NAGOYA AND AICHI SHIPYARDS VISITS - TRIP NOTES

(*indicates information duplicated in formal Trip Report, file: ihi1.doc)

Attachments (A) Standards Management Processes
(B) Shipbuilding Information Management System and CAM "Klean System" Production Control Flow Charts

MONDAY, 27 NOVEMBER, 1995 - IHI HEADQUARTERS

Welcome by Mr. Hideaki Kobayashi, Senior Technical Advisor. Also present: Mr. Norio Hata (Project Leader, AJISIA, CALS) Naval Architect, Mr. Kazutoshi Yamamoto, Senior Manager, Sales and Marketing Headquarters and Mr. Ken Okabayashi, ABS Manager - Japan.

- US is ahead of technological information by use of electronics - PC's, Internet, LAN's etc..

Mr. Norio Hata - CAD System Overview

- CAD system name - AJISAI H(hull) and F(outfit)
- Scheduling system for CAM still under development. Some areas of shop systems are in place - other areas are given priority as requested by the individual shops.
- IHI customers fully knowledgeable of JIS and accept as stated. Vendors selection developed by IHI and reviewed by customer. Ultimate vendor selection normally made by IHI. (Customers more concerned with warrantee and reliability of the product.)
- Started to develop various computer systems 3 years ago to get current with state of the art. 15 years ago, IHI applied introduction of CAD systems to their yards. Limited by hardware capacity from shipbuilding application. Hardware improvement now suitable and they are in the development stages to apply to the whole ship. Hull structure is 70-80% complete and outfit areas 20-30%.
- * Can now apply 3D surface modeling (wire frame) to hull design. Expect to finish next year with 100% CAD capability, for both hull and outfit design. (AJISAI F is ~ 50% complete today). They need more hardware installed to implement.
- IHI wants to apply interference checks to AJISAI F.
- Standards for shape parametrics now in CAD AJISAI H data base for plates and hull structure.
- Structural changes do not automatically get reflected in subsequent or outfit related drawings. Must rely on the designer to communicate change to assure related drawings are checked for interference.
- Pipe size of $\leq$ 20mm are not modeled. Very large assemblies are standardized for multiple ship application.
- Mr. Kobayashi desires to have "paperless" shops - thinks they are 10 years away.
- Joint team utilized to develop production plan. Input to initial design may use production personnel - but not as a rule.

- **Material control system very important to standardization. Names and P/N's are unique and common. Presently, majority of items given a serial number except free (bulk) stock and standard material.**
- **Piping material generally steel, but CUNI and SS are used occasionally.**
- **Times for basic design, start fab, etc., after contract award is:**
  - ⇒ **3 months for basic design**
  - ⇒ **3 months for functional design (key plans - i.e., diagrams) and drawing approval**
  - ⇒ **4-5 months for production design - AJISAI H and F (Starts ~ 2 months after functional design starts)**
  - ⇒ **Start fab 9-10 months**
  - ⇒ **Lay keel 11-13 months**
  - ⇒ **Launch 2-3 months after keel**
  - ⇒ **Delivery 3-4 months after launch**

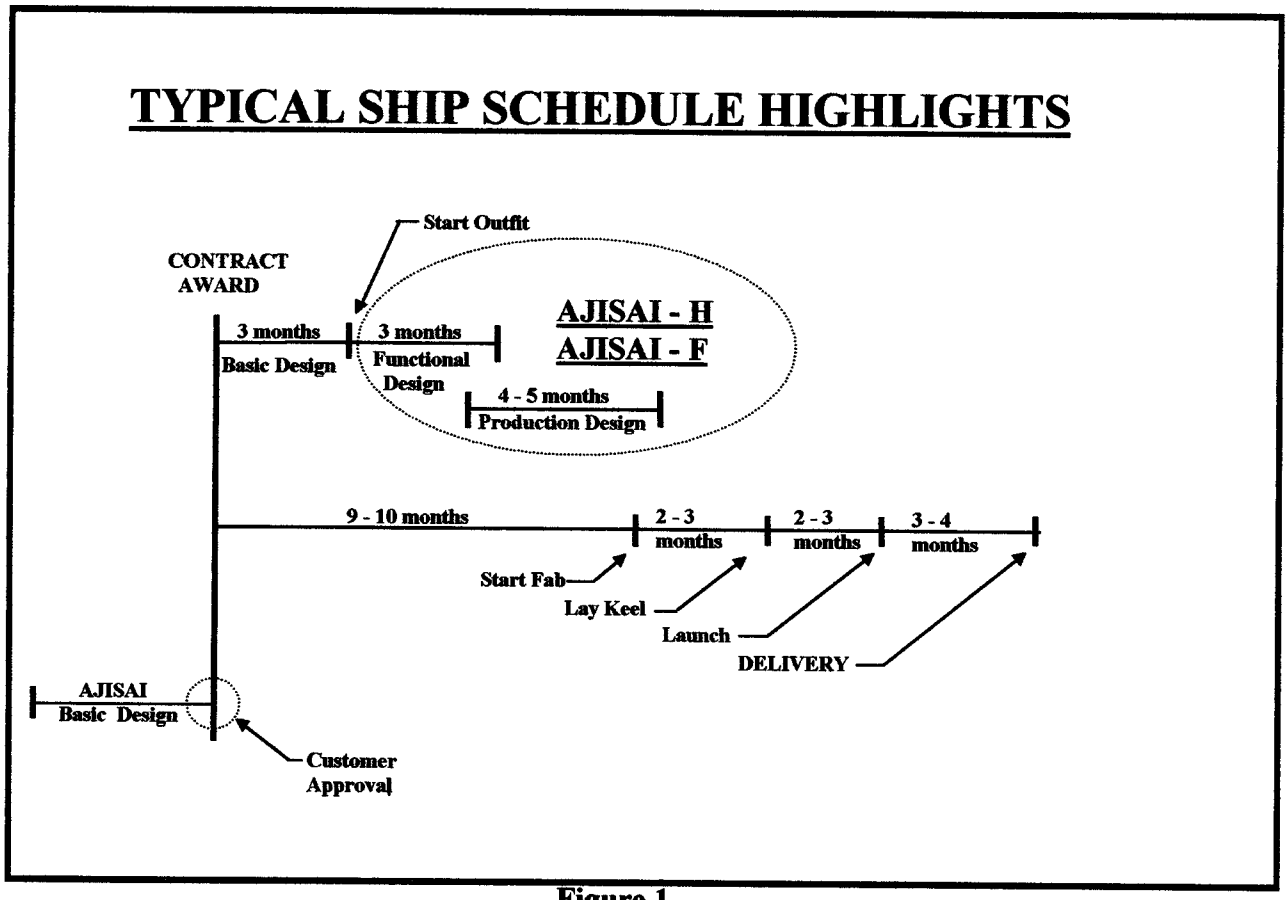


Figure 1

- **IHI capable of delivering 4-5 ships of the same class per year - VLCC's, container ships and bulk carriers.**
- **Estimate of pipe fittings and valves count done manually for procurement**

- Production Engineering provides dimension compensation for effects of welding depending on the processes.
- JIS input is often provided by a joint shipyard team via JMSA.
- * Design departments at IHI shipyards are assigned maintenance and/or creation of standards. Steel plate standards controlled by steel mill. Common IHI standards are assigned a shipyard standard number for maintenance purposes.
- Aichi and Kure Shipyards are ISO 9001 from basic design to construction.
- * Standards are revised every 3-5 years, depending on the level of the standard or importance of the change.
- Standards changes are subject to approval by discipline committee chairman, department chairman or cognizant section manager. Example, hull fitting standard changes and/or creation, are the responsibility of the Design Manager at the AICHI shipyard.
- * IHI philosophy is that standards must be developed and maintained by the persons that use them.
- * Present shipyard standards are paper based. IHI moving towards electronic data base standards.
- IS (standard at IHI) will use JIS and ISO or others and add information to suit shipyard applications. Significant commonality may/does exist.
- Library of other standards are available at IHI.
- IGES 2D application protocol is used somewhat for exchange of information with other shipyards and vendors.
- IHI uses ASTM specifications sparingly.
- CFE information from selected vendors is generally readily available - however, they do encounter equipment furnished not in accordance with plan.. In these cases, claims are processed, yet not always paid. Japanese vendors are good. European suppliers are less concerned. IHI often sends a designer to get information on design from foreign equipment suppliers.
- Design Engineers and, if required, designers, often are a part of the contract negotiating team.
- IHI has representatives in Europe and USA to pursue other standards as necessary.
- At vessel launch, outfitting is 80-90% complete.
- Shipyard activation and test is a function of area, i.e., welding is a QC item and controlled by production. Speed runs are a design function and controlled by engineering. Owners most always provide trials crew; however, shipyard will provide activation crew up to trials.

Mr. Kazutoshi Yamamoto, Senior Manager, Sales and Marketing Headquarters

- 2900 people in shipbuilding in 3 IHI shipyards. 16,500 total IHI employees covering 6 major divisions. Refer to Enclosure (2), The History of IHI and Company Profile.

Mr. Akito Shida, Manager, Strategic Planning Group

* • **At IHI shipbuilding peak 25 years ago, IHI world market share was 9.4%, dropping to 7.4% by 1976 and is currently at 4%. In 1974 IHI built ~2.5 million tons. 15 years ago, 16K people were employed in IHI shipbuilding and repair. Subsequently shifted to other IHI industries. There may be another shift in the future with more shipbuilding people having to move, due to lower market share and world shipbuilding demand. Aichi shipyard to close, ~600 people, (100 from design), to be transferred to Tokyo or Kure shipyards or to other IHI divisions. IHI will focus on the continued development of the Kure and Tokyo shipyards.**
- **IHI current shipyards:**
  - ⇒ **3 Main Shipyards:**
    - **Tokyo Shipyard - Tokyo**
    - **Aichi Works - Nagoya**
    - **Kure Shipyard - Kure**
  - ⇒ **2 Repair yards:**
    - **Yokahama Shipyard - Yokohama**
    - **Aioi Shipyard - Aioi**

* • **Does not believe total market share will change due to Korean increased shipbuilding capacity. Last year - Japan had ~40% and Korea had ~30%.**

* • **Total shipbuilding market demand is expanding worldwide. IHI projects 20 million tons of new ship demand, with 10% for increased shipping capacity and 90% for vessel replacement. Further, anticipates 30 - 40 VLCC's per year fir the next 25 years - replacement and new pollution control requirements.**
- **Container ships to increase in size/capacity from 5000 to 6000 TEU.**
- **Currently have seven 170 DWT Bulkers, over next 2 years. 40M beam called "Cape" design - not Panamax.**
- **Currently building five 4000TEU SeaLand containerships - three already delivered.**
- **Set up a new company in partnership with Mitsubishi to build Naval Combatants. Currently building one with Mitsubishi building three.**
- **OECD agreement - IHI does not see any impact either way on resolution of this issue.**
- **Most medium sized Japanese yards have many local subcontractors. 10% employees and 90% subcontractors. Japan has 7 major shipyards. All other yards considered medium or small - some of which can build Panamax size vessels.**
- **Productivity growth as a function of automation ~ 15 - 20%, assuming building the same class vessel.**

* • **IHI keenly aware of ship costs and is working to decrease people while maintaining capacity in an effort to remain competitive.**
- **Aioi shipyard builds all commercial deckhouses for all IHI yards - 10 - 12 per year. Units are barged to vessel construction yard.**
- **Outfit levels currently to 93% prior to erection.**

- **Present construction contracted at the three IHI new construction shipyards (12 vessels, 1 LPG/FSO Facility):**
  - **⇒ Tokyo Shipyard**
    - **1 DDG**
    - **2 High Speed (30kt) 20ton ferries - auto and passenger**
    - **1 DD**
    - **1 Research Vessel**
  - **⇒ Aichi Shipyard**
    - **1 Containership - 4000 TEU**
    - **1 LPG/FSO (Floating, Storage and Off-loading)**
  - **⇒ Kure Shipyard**
    - **2 Containerships - 4000TEU**
    - **3 Cape size Bulkers**
    - **1 VLCC**
- **Aichi to close in 1996 at completion of LPG/FSO**
- **IHI schedules do not deviate from original schedules for major events. Schedule responsibility driven to lowest level in yards in areas of responsibility.**

TUESDAY 28 NOVEMBER, 1995 - IHI TOKYO SHIPYARD

Mr. Yuzo Yamada, Manager, Engineering Administration Group.

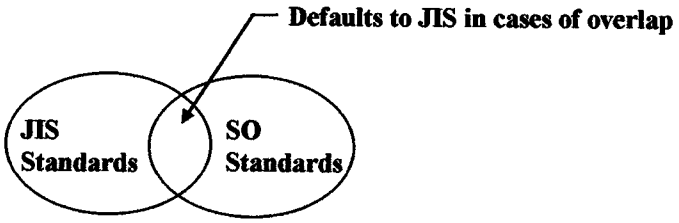
- **Provided handout - "Documentation System of ISO 9001", part of IHI Business Rule Standard, applies to SPAIS, QISSP, IS-SOT, IS-SO, refer to Attachment (A).**
- **ISO 9000 is 90% applied. Technical standards are commonly used by all three new construction shipyards (are considered Level II). Level III standards are prepared in each department (QC Process Chart, Standard Drawing Checklists, etc.).**
- **Business Rules Standards are contained in one large volume.**
- **Other Standards Acronyms**
  - **⇒ SPAIS - Shipbuilding Process and Inspection Standard**
  - **⇒ QISSP - Quality and Inspection Standard for Ship Painting**
  - **⇒ IS-SOT - Technical Standards**
  - **⇒ IS-SO - Standard Drawings for fittings and hardware**

Mr. Ichiro Ogura, Manager, Quality Assurance Group

- **5548 total production standards. Refer to Attachment (A) for breakdown by category.**
- **The Standards review frequency established by ISO 9000 - for Level II.**
- **IHI had a Standards Group (vs. committees) more than 10 years ago. Basically used JIS. Today, the "Standards Group" is comprised of many main committees and sub committees within each discipline.**
- **The preparation, review and approval responsibilities for the principle IHI standards are shown in the following table:**

IHI STANDARDS APPROVAL MATRIX			
TITLE	**PREPARATION**	**REVIEW**	**APPROVAL**
SPAIS	QC Committee	Chairman of QC	Manager of QA
QISSP	Painting Committee	Chairman of Paint	Manager of QA
BR	Each Department	Assigned Section Manager	Manager of Each Department
IS-SOT	Assigned Department	Technical Committee	Chairman of Technical Committee
IS-SO	Assigned Department	Technical Committee	Chairman of Technical Committee

- IHI continues to use JIS as their principal choice for standards as a first choice. If the customer wants something different from JIS, it is covered by IHI SO standard.



- If owners want a different National Standard, IHI has most of them in their Corporate Library.
- In recent years, IHI has increased machinery import of items not governed by JIS. This is normally the result of the owners request.
- When a ships price is quoted, it is based on a standard list of equipment manufacturers. If the owner does not want a specific manufacturer, IHI will revise quote depending on the manufacturer selected by the owner. Original list normally offers multiple choices of manufacturers for each equipment required.
- Not all drawings for a vessel are submitted to the customer for approval.
- IHI is used to making the majority of decisions as to specific equipment procured for a ship.
- At the beginning of applying ISO, IHI reviewed all their standards and reduced total number. They are not overly concerned with the total numbers required to be maintained; however, they believe they do need to reduce their number of total standards and are working to accomplish.

WEDNESDAY NOVEMBER 29, 1995

Mr. Noritaka Uesugi - Aichi Shipyard

- **Wiring done in 2D CAD. Hull, Machinery Arrangement and Piping is done in 3D CAD. HVAC not in CAD this year but will be next year.**
- **AJISAI H (hull) and F (outfitting)CAD - upper level menu system used to call up required areas.**
- **AJISAI H - Design standards incorporated into CAD allow automatic calculation of plate thickness as a function of location and purpose. Bracket detail design also done.**
- **AJISAI F - Piping done on AJISAI H background structure. Changes to hull model are communicated verbally to outfit designers when modified hull model is incorporated into existing outfit drawings. Interferences are not automatically flagged or highlighted.**
- **Machinery parts are developed in a PC and sent to CAD library for use incorporation in model, as used. (pumps, valves, motors, etc.)**
- **Foundations for machinery and fittings are developed after firm location selected for component.**
- **Insertion points, for library parts, use frame numbers + distance, centerline offset, height, etc.. Minimal design information necessary for machinery arrangement installations.**
- **Engine (or any equipment) specifications are entered ;into CAD - including price.**
- **Electrical wireways laid out in "2.5D" CAD (height shown), following conversion of 3D Machinery Arrangement Model, to permit early estimate and ordering of cables.**
- **For electrical 2.5D layout, Z dimension (height) is a default setting unless otherwise specified by manual input.**
- **Node points are entered for subsequent calculations to provide exact cable lengths required.**
- **Wiring layout precedes cable tray design. Cable tray design follows same path established by early layout for cable estimate.**
- **Wiring design information is entered as a standard.**
- **AJISAI F is 100% complete for wire and pipe - working to complete HVAC, Access, and etc.. Expect to be ready for test by March 1996 and fully on line by August 1996.**
- **AJISAI H application is 2-3 years old.**
- **Diagrams and Key plans are not in CAD yet. IHI is expediting development.**

THURSDAY NOVEMBER 30, 1995

Mr. Tako Ito - Kure Shipyard

- **Kure shipyard established in 1889 - Pre WW2 builder of BB Yamato. Has built over 500 vessels over history of shipyard. IHI purchased Kure shipyard in 1968. Number 1 graving dock filled in 3 years ago for construction of state of the art**

steel panel and assembly shop. Shop has been on line for 1 year. Welding robots used throughout.

- There are 1200 people (engineers and blue collar workers) at Kure, plus 100 subcontractors - painters and welders - for the assembly stages.
- Two paint shops.
- Maximum unit weight, length and beam:
  - ⇒ #2 dock - 300 tons, length 295 m and beam 60 m
  - ⇒ 540 tons, 540 tons, length 510 m, and beam 80 m

Mr. Musataka Kakimoto

* • Production control shop processes on line - erection schedules not on line yet. Utilizes Klean System software in Windows format. Demonstration given, (using PC graphics projected to screen), and handouts provided. Refer to Attachment (B). Their production control system appeared to be very easily monitored, adjusted and maintained.
  - ⇒ CAM Production Control system allows menu selection for any applicable schedule for major components/units. Each block has a line schedule shown - multiple blocks shown on one screen.
  - ⇒ System shows blocks location for any given date. Can quickly locate units on shipyard overlay by selecting specific block. Selected block appears in red.
  - ⇒ Provides information as to what portion of an area is able to do more work at any specific time and to what extent (%).
  - ⇒ Movement of blocks done automatically by CAM to match entered dates.
  - ⇒ CAM Production Control (Microsoft Windows, version 3.1), is on line in all areas of fabrication, assembly and erection for steel and outfitting.
  - ⇒ 16-20 people cover entire shipyard for Production Control.
  - ⇒ Periods, man-hours, dates, etc., are established in a standards database for each unit/block, in a block master schedule. Monthly schedules are developed from the block master schedules.
  - ⇒ Foremen can change schedules as he reviews actuals. Block progress is checked daily.
  - ⇒ Total CAM Production Control System developed in 1 year by IHI personnel.
  - ⇒ System tracks man-hours for each worker against each unit or block. Net result is a very sophisticated production control system in Microsoft Windows.
- IHI has 8 - 10 people working CAD system development at Kure.

ATTACHMENT (A)

Standards Management Practices

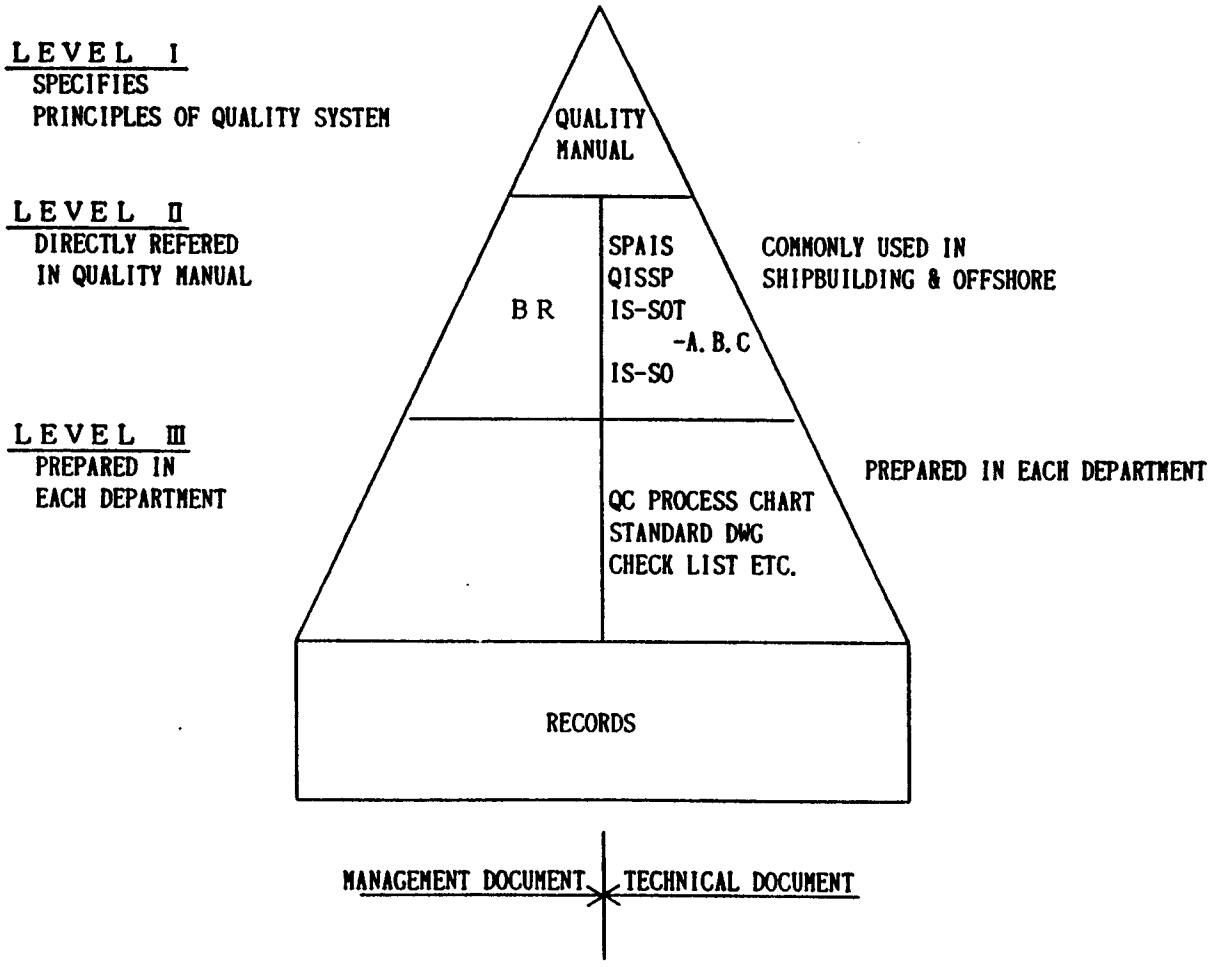
- **Document System (chart) of ISO 9001**
- **A System of Standards**
- **Organization of Technical Committees**
- **Number and Type of Standards**
- **Processes in Standards Registration**
- **Processes in Standardization**

MEETING AGENDA

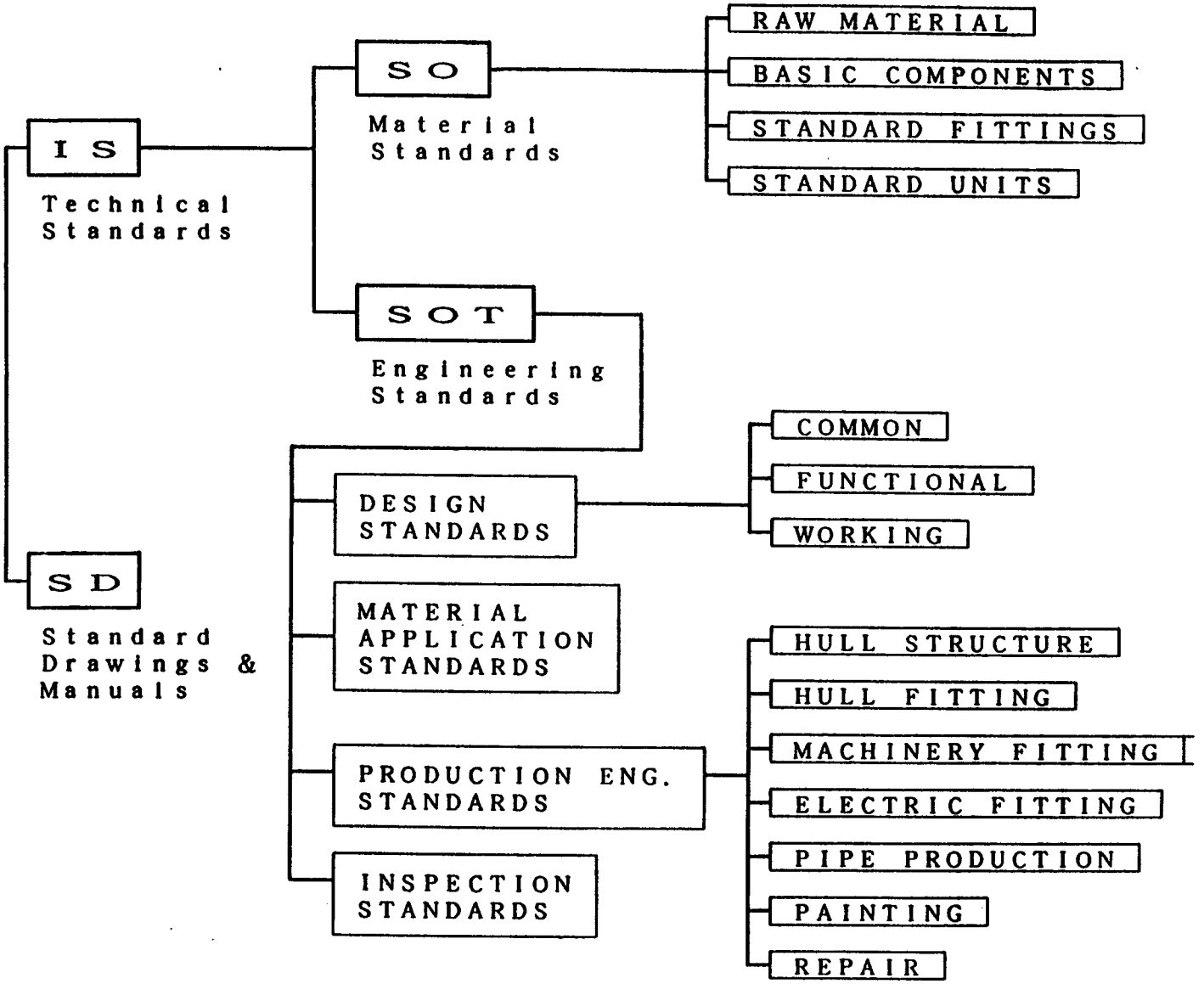
1. EXPLANATION FROM IHI

   - DOCUMENT SYSTEM OF ISO 9001
   - SYSTEM OF STANDARDS
   - ORGANIZATION OF STANDARDS
   - NUMBER OF STANDARDS
   - PROCESS OF STANDARD REGISTRATION
   - PROCESS OF STANDARDIZATION

2. Q & A



DOCUMENT SYSTEM OF ISO 9001



A SYSTEM OF STANDARDS

IN SHIP & OFFSHORE DIVISION

SYSTEM. JSW

SOT : ENGINEERING STANDARDS

- MATERIAL APPLICATION STANDARDS : SOT-XXXXXX
- DESIGN STANDARDS : SOT-AXXXXX
- PRODUCTION STANDARDS : SOT-BXXXXX
- INSPECTION STANDARDS : SOT-CXXXXX

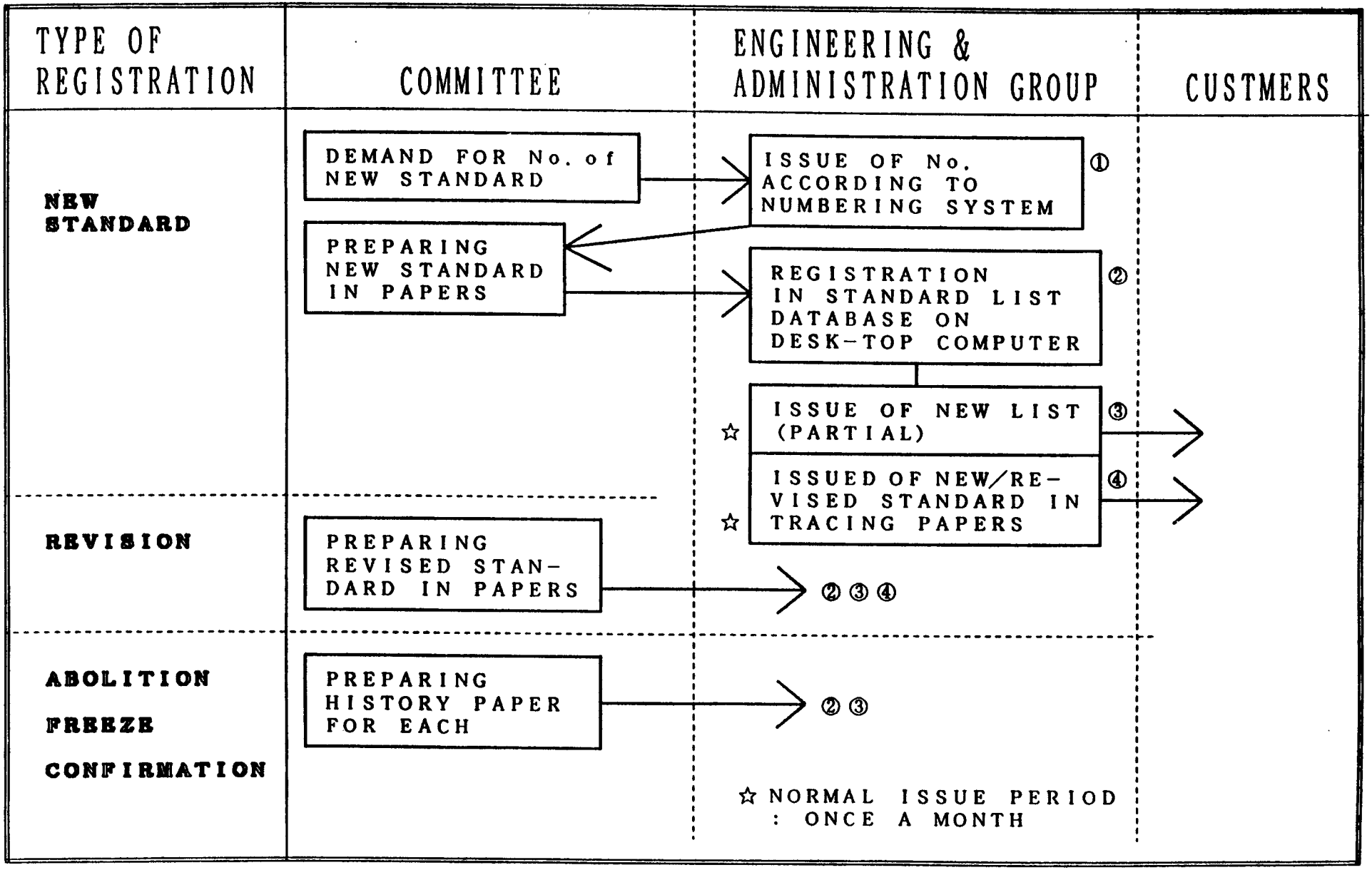
ORGANIZATION OF TECHNICAL COMMITTEE

SHIP & OFFSHORE DIVISION

COMMITTEE	SUB-COMMITTEE
COMMON STANDARD	
STRUCTURE & STRENGTH DESIGN	HULL, GENERAL
	HULL, WORKING PRACTICE
	VIBRATION
PAINTING DESIGN	
FITTING DESIGN	ACCOMMODATION
	HULL FITTING
	NOISE
MACHINERY FITTING DESIGN	MACHINERY FITTING
	SHAFTING
ELECTRIC & CONTROL DESIGN	POWER & ELECTRONICS
	CONPUTER
	FITTING & LIGHTING
PRODUCTION ENGINEERING	HULL STRUCTURE
	WELDING
	HULL FITTING
	ACCOMMODATION
	MACHINERY FITTING
	ELECTRIC FITTING
	PIPE PRODUCTION
	PAINTING
OFFSHORE	

CODE	STANDARDS ITEMS	NUMBERS			TOTAL NUMBERS
		SO	SOT	SD	
C	COMMON SO	431	25	276	732
CF	COMPUTER PROGRAM, FITTING	0	7	296	303
CT	COMMON SOT	0	47	36	83
E	ELECTRIC FITTING DESIGN	195	195	75	465
EF	ELECTRIC FITTING	0	0	74	74
EQ	ELECTRIC INSPECTION	0	23	0	23
FP	PAINTING	0	28	9	37
FQ	HULL FITTING INSPECTION	0	112	1	113
GQ	QUALITY CONTROL	0	7	8	15
HC	COMPUTER PROGRAM, HULL	0	0	276	276
HF	HULL STRUCTURE PRODUCT.	0	42	26	68
HK	HULL STRUCTURE DESIGN	0	162	128	290
HQ	HULL STRUCTURE INSPECTION	0	16	6	22
HV	VIBRATION	0	19	29	48
HW	WELDING	0	3	2	5
HY	HULL STRUCT. PRODUCT. DESIGN	0	205	13	218
J	ACCOMMODATION DESIGN	235	121	282	638
JF	ACCOMMODATION FITTING	0	0	57	57
K	SHIPS CALCULATION	0	40	77	117
M	MACHINERY FITTING DESIGN	128	145	225	498
MF	MACHINERY FITTING	0	18	53	71
MQ	MACHINERY FITTING INSPECTION	0	46	1	47
N	NOISE	0	18	8	26
O	HULL FITTING DESIGN	464	207	266	937
OF	HULL FITTING	0	4	46	50
P	ENGINEERING ADMINISTRAION	0	48	29	77
PC	PAINT. & ANTI-CORROSION DES.	0	12	5	17
PF	PIPE PRODUCTION	0	55	0	55
RR	REPAIR	0	5	79	84
S	SHAFTING SYSTEM	4	59	35	98
X	COMMON FITTING	0	3	1	4
		1457	1672	2419	5548

標準件数. JW3



PROSESSES IN STANDARD REGISTRATION

REGIST. J

NECESSITIES OF NEW STANDARD & REVISION	COMMITTEE	ENGINEERING & ADMINISTRATION GROUP
(1) FEED BACK FROM DELIVERED VESSELS ・DAMAGES, etc. (2) FEED BACK FROM PRODUCTION DEPT. ・NEW PRODUCT. METHOD ・NEW PRODUCT. FACILITIES (3) FEED BACK FROM DESIGN DEPT. (IMPROVEMENT, RATIONALIZATION)	(1) PREPARATION OF NEW STANDARD (2) MAITENANCE OF EXISTING STANDARDS IN ACCORDANCE WITH THE "REVIEW" TERM SO : 4 YEARS SOT: 3 YEARS SD : 5 YEARS AFTER "REVIEW", STANDARD IS DIVIDED INTO THE FOLLOWING STATUS. "ABOLITION" "FREEZE" "REVISION" "CONFIRMATION"	(1) REGISTRATION (2) ISSUE/INFORMATION TO EACH DEPARTMENT (3) STORAGE OF ORIGINAL PAPERS (4) ANNOUNCEMENT OF "REVIEW" TERM FOR EACH STANDARD (5) ALLOTMENT AND CONTROL OF COMMITTEE BUDGET

PROCESSES IN STANDARDIZATION

FLOW. J

ATTACHMENT (B)

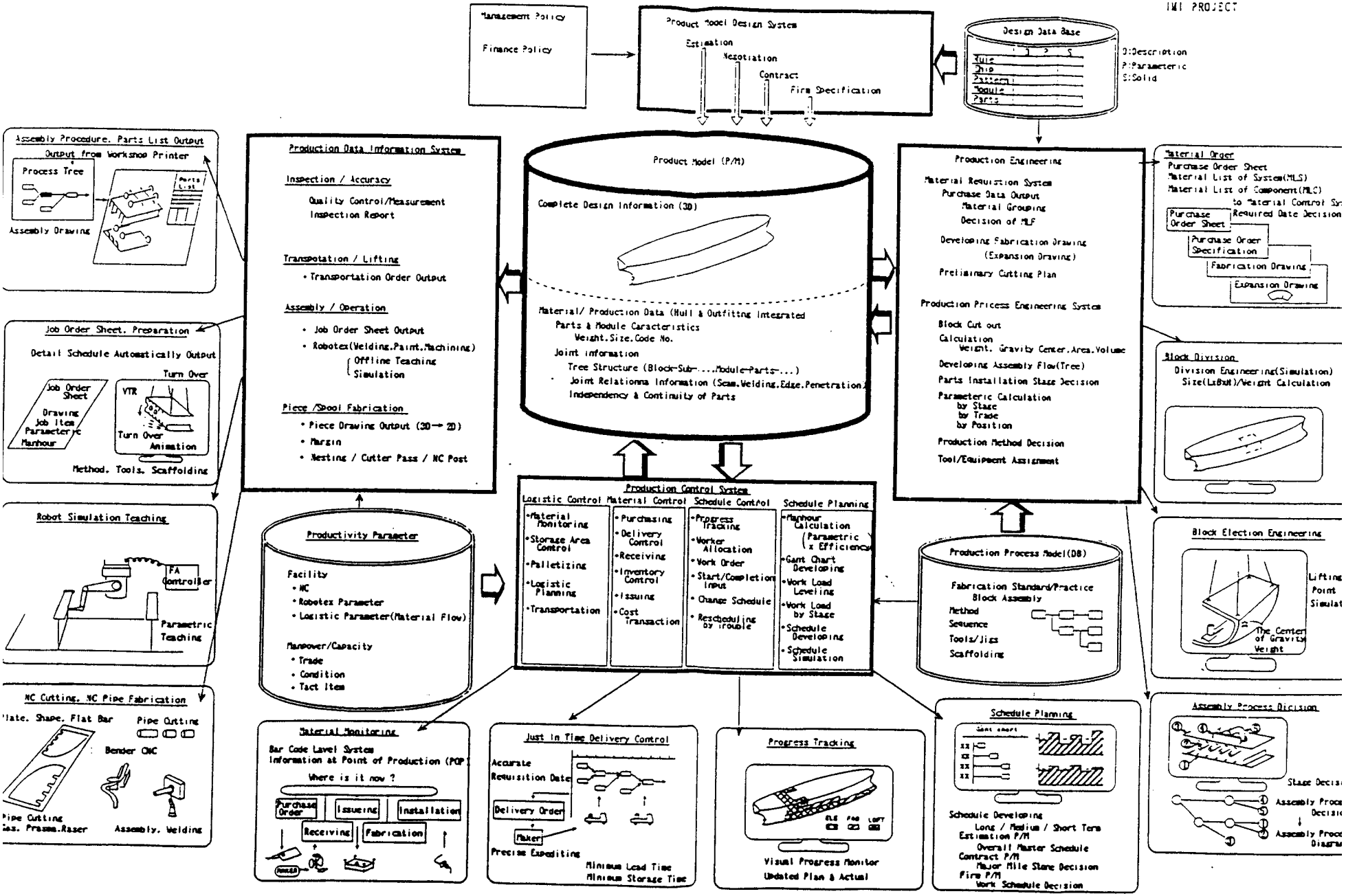
- **Shipbuilding Information Management System by Product Model**
- **Characteristics of CAM "Klean System" - IHI's Production Control Scheduling and Progress Check System of Shops**

SHIPBUILDING INFORMATION MANAGEMENT SYSTEM BY PRODUCT MODEL

July .. 1994

IHI Marine International

IMI PROJECT



Characteristics of KLEAN SYSTEM

1. SCHEDULE PLANNING WITH HIGH ACCURACY &SPEED

- Simulation functions are built in.
  Ex.) Work Load sum up function is available for almost all schedule patterns.
  For Weekly Detail Schedule, schedule bar charts and allocation plan of work unit are linked.
- Easy to refer results(Schedule, Man Hours, Work Load) of Past Sister Ships
- Work Loads of work units are transfered from Design Section through LAN timely.

- Accurate Work Load can be accepted from CAD with Product Model.

2. VISIBLE MANAGEMENT ON <MS-WINDOWS> SYSTEM

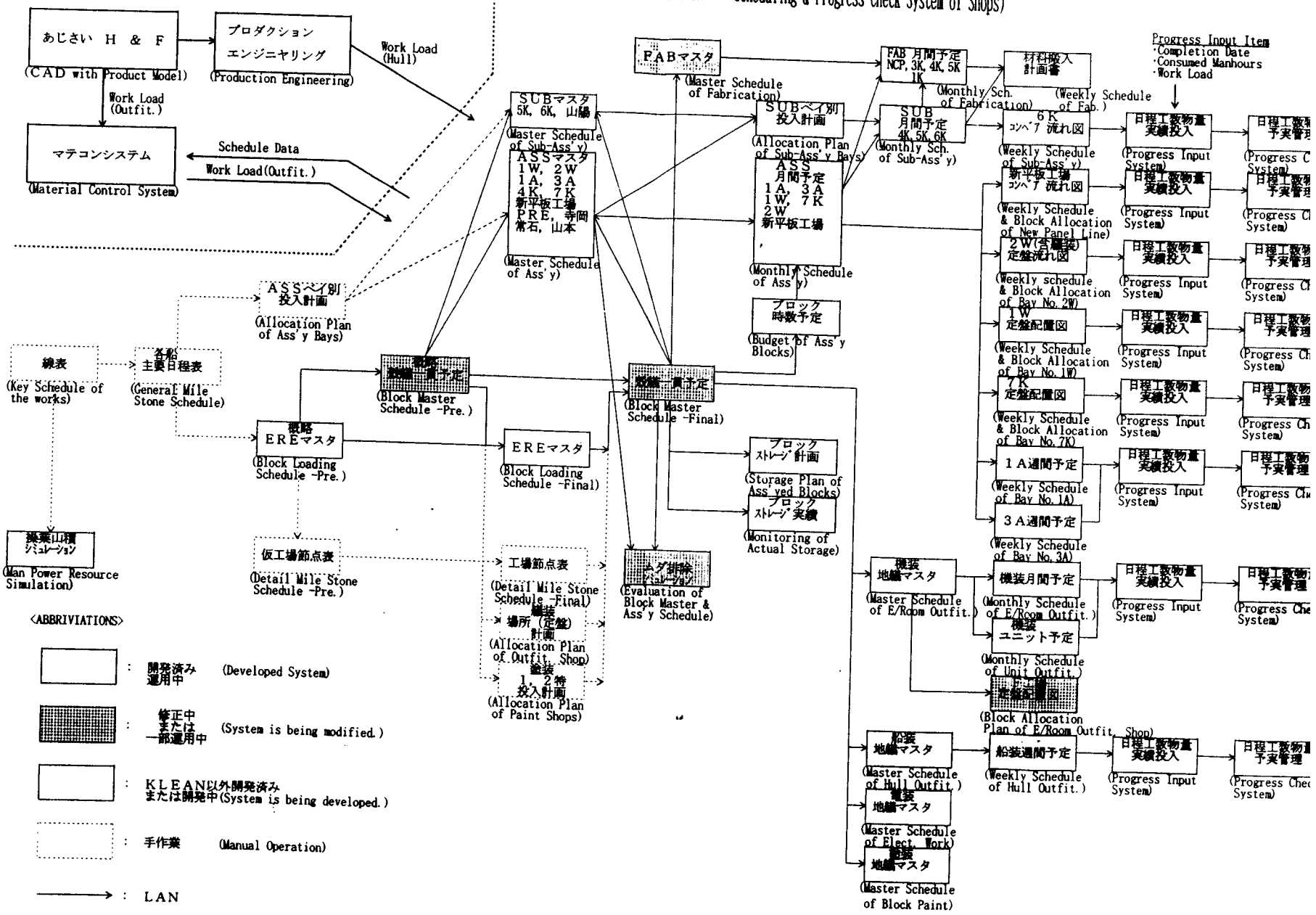
- Real Time Monitoring of Progress(Schedule, Man Hour, Work Load)

3. CUSTOMIZED SYSTEM TO FOLLOW DETAIL NEEDS OF FOREMAN

- No Incompatibility for foreman to use the new system

KLEAN地上日程体系

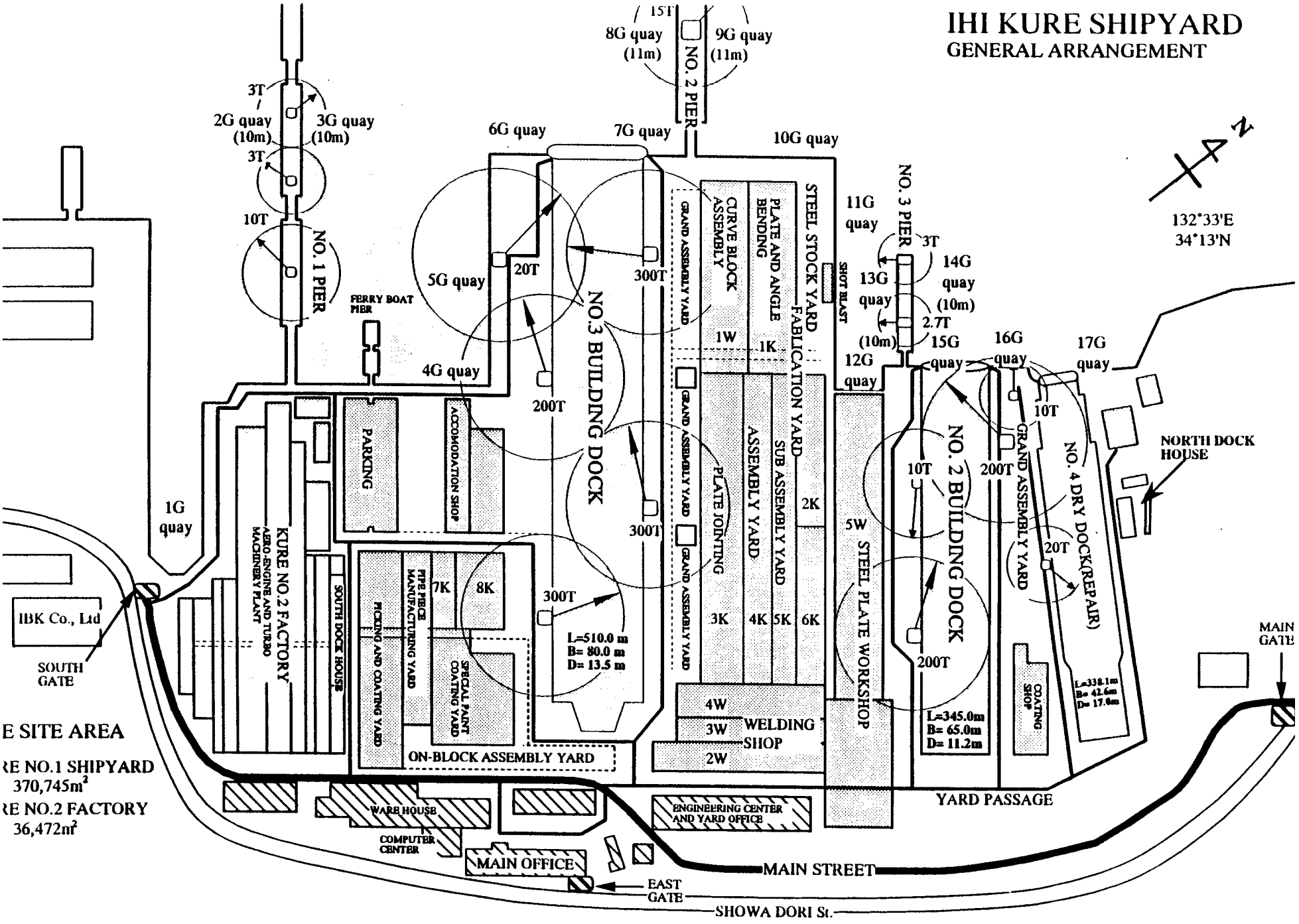
(KLEAN SYSTEM — Scheduling & Progress Check System of Shops)

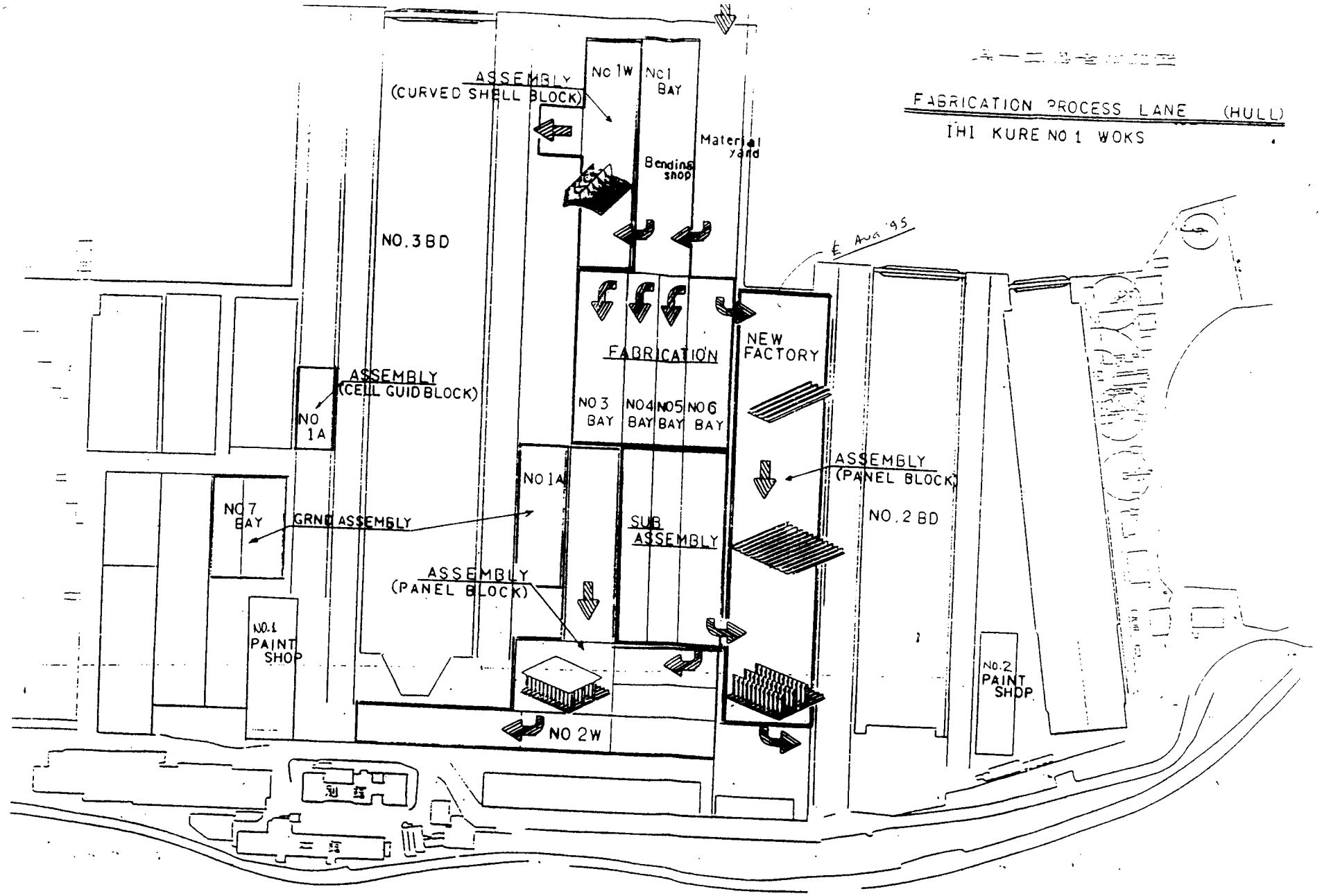


ENCLOSURE (2)

- **Aerial Photos of IHI Tokyo, Aichi and Kure Shipyards**
- **Shipyard Layout Graphics**
- **IHI Organization Chart and Aichi Shipyard Organizational Responsibilities**

Brochure omitted on the request of the shipyard.


IHI KURE SHIPYARD
GENERAL ARRANGEMENT
132°33'E
34°13'N
NO. 1 PIER
NO. 2 PIER
NO. 3 PIER
8G quay (11m)
9G quay (11m)
15T
3T
2G quay (10m)
3G quay (10m)
10T
6G quay
7G quay
10G quay
11G quay
5G quay
20T
300T
4G quay
200T
FERRY BOAT PIER
NO.3 BUILDING DOCK
GRAND ASSEMBLY YARD
CURVE BLOCK ASSEMBLY
PLATE AND ANGLE BENDING
STEEL STOCK YARD
FABLICATION YARD
SHOT BLAST
1W
1K
PLATE JOINTING
ASSEMBLY YARD
SUB ASSEMBLY YARD
2K
3K
4K
5K
6K
5W
STEEL PLATE WORKSHOP
4W
3W
WELDING SHOP
2W
ON-BLOCK ASSEMBLY YARD
13G quay (10m)
14G quay (10m)
12G quay
15G quay
16G quay
17G quay
2.7T
NO. 2 BUILDING DOCK
L=345.0m
B= 65.0m
D= 11.2m
NO. 4 DRY DOCK(REPAIR)
L=338.1m
B= 42.6m
D= 17.0m
COATING SHOP
NORTH DOCK HOUSE
1G quay
PARKING
ACCOMODATION SHOP
KURE NO.2 FACTORY
AERO-ENGINE AND TURBO MACHINERY PLANT
SOUTH DOCK HOUSE
PIPE PIECE MANUFACTURING YARD
PICKING AND COATING YARD
SPECIAL PAINT COATING YARD
7K
8K
L=510.0 m
B= 80.0 m
D= 13.5 m
IBK Co., Ltd
SOUTH GATE
MAIN GATE
E SITE AREA
RE NO.1 SHIPYARD
370,745m²
RE NO.2 FACTORY
36,472m²
WARE HOUSE
COMPUTER CENTER
MAIN OFFICE
ENGINEERING CENTER AND YARD OFFICE
YARD PASSAGE
MAIN STREET
EAST GATE
SHOWA DORI St.


FABRICATION PROCESS LANE (HULL)
IHI KURE NO 1 WOKS
ASSEMBLY (CURVED SHELL BLOCK)
No 1W
No 1 BAY
Material yard
Bending shop
NO.3 BD
FABRICATION
NEW FACTORY
NO 3 BAY
NO4 BAY
NO5 BAY
NO 6 BAY
ASSEMBLY (CELL GUID BLOCK)
NO 1A
ASSEMBLY (PANEL BLOCK)
NO.2 BD
NO 1A
NO 7 BAY
GRND ASSEMBLY
SUB ASSEMBLY
ASSEMBLY (PANEL BLOCK)
NO.1 PAINT SHOP
NO.2 PAINT SHOP
NO 2W

IHI ORGANIZATION

As of July 1st 1995

Board of Directors

Chairman and Chief Executive Officer
K. Inaba

President and Chief Operating Officer
T. Tanii

Committee of Managing Directors

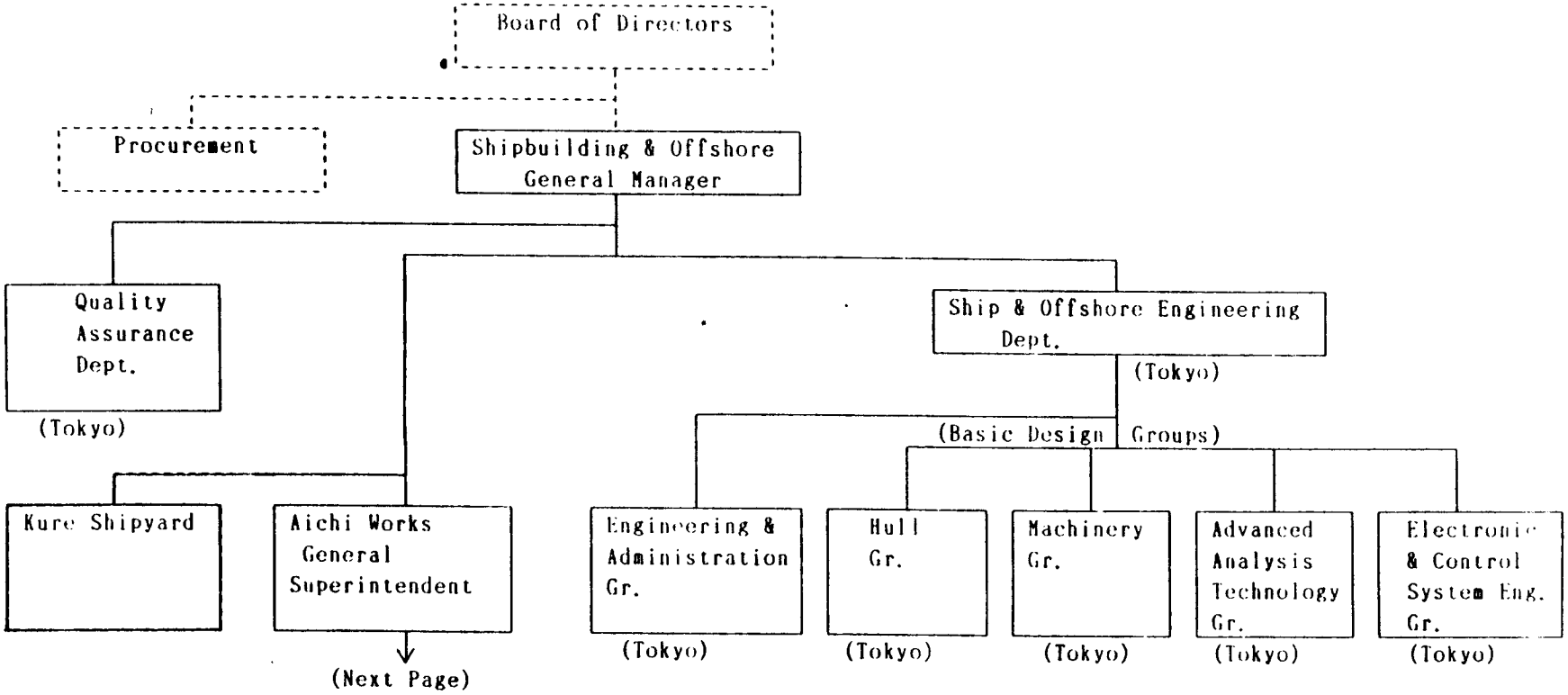
Auditors

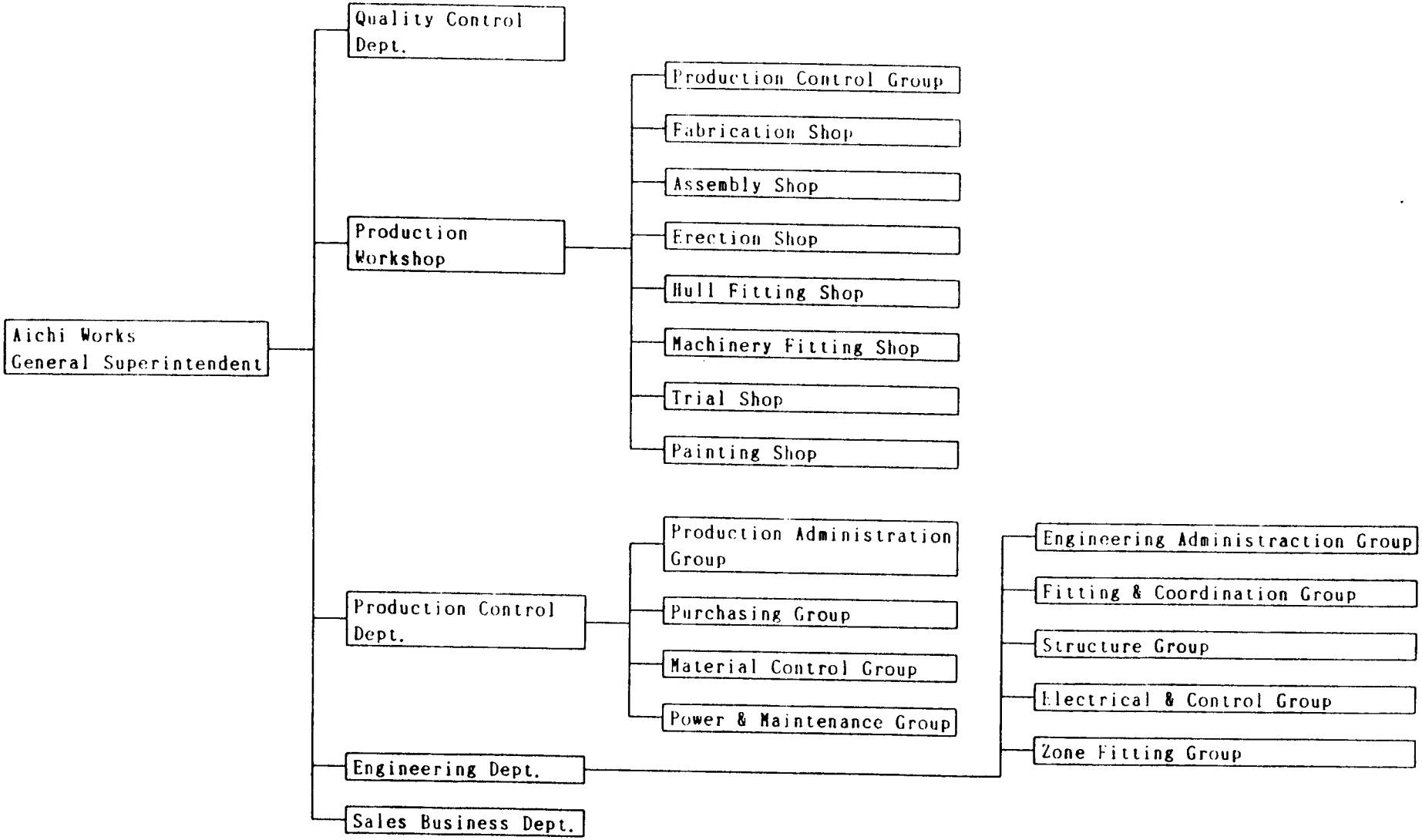
- Internal Audit Div. — Y. Ishikawa (Gen. Mgr.)
- Secretariat Div. — F. Koda (Gen. Mgr.)
- Corporate Planning Div. — M. Hirano (Gen. Mgr.)
- Public Relations & Advertising Div. — F. Usami (Gen. Mgr.)
- Administration Div. — M. Sekine (Gen. Mgr.)
- Personnel Div. — [illegible] (Gen. Mgr.)
- Labour Relations Div. — N. Asazawa (Gen. Mgr.)
- Finance Div. — M. Kawano (Gen. Mgr.)
- Accounting & Budgeting Div. — M. Nakajima (Gen. Mgr.)
- Associated Company Div. — T. Asano (Gen. Mgr.)
- Procurement Div. — Y. Mineguchi (Gen. Mgr.)
- Information Systems Div. — T. Miyake (Gen. Mgr.)

- Technical Development — K. Matsuzuna (Gen. Mgr.), H. Ogawa (Deputy Gen. Mgr.), Y. Oka (Ditto), T. Miura (Ditto), T. Yamazaki (Ditto)
  - Research Institute — T. Yamazaki (Director of Institute)
  - Mechatronics Development Center — T. Miura (Director of Institute)
  - Advanced Production Engineering Center — Y. Oka (Director of Institute)
- Real Estate Business Div. — A. Nagasawa (Gen. Mgr.)
- Sales Administration — K. [illegible] (Gen. Mgr.), K. Minato (Deputy Gen. Mgr.)
  - Domestic Sales Offices
- International Operations — M. [illegible] (Gen. Mgr.), T. [illegible] (Deputy Gen. Mgr.)
  - Overseas Sales Dept.
  - Overseas Offices
- General Affairs Div., Tokyo
- General Affairs Div., Musashi
  - Headquaters Representative's Offices

- Machinery & Structures — S. Nakatsu (Gen. Mgr.), M. Imai (Deputy Gen. Mgr.), A. Onno (Ditto), M. Kodama (Ditto)
  - Domestic Sales Dept.
  - Materials Handling Equipment Div.
  - Hydraulic Machinery & Shield Machine Div.
    - Nagoya Works
  - Steel Structure Div.
    - Sunamachi Works
  - Bridge Div.
    - Yokohama Heavy Structure Works
  - Environmental Equipment Div.
  - Kure Shingu Works
- Industrial Machinery — H. Wasa (Gen. Mgr.), T. Kiga (Deputy Gen. Mgr.), H. Ogawa (Ditto)
  - Domestic Sales Dept.
  - Physical Distribution System Div.
  - Industrial Machinery Div.
    - Yokohama Machinery Works
  - Parking System Div.
  - General Machinery Div.
- Energy & Chemical Plants — K. Nojima (Gen. Mgr.), E. Inoue (Deputy Gen. Mgr.)
  - Domestic Sales Dept.
  - Power Plant Div.
    - Aioi Works
  - Nuclear Power Div.
    - Yokohama Nuclear & Chemical Components Works
  - Plant Engineering Div.
- Shipbuilding & Offshore — M. Miyazaki (Gen. Mgr.), Y. Igarashi (Deputy Gen. Mgr.), S. Hirano (Ditto), T. Nakajima (Ditto)
  - Ship Sales Dept.
  - Offshore / Water-Front Development & LNG Ship Sales Dept.
  - Naval & Special Vessel Sales Dept.
  - Technology Development Dept.
  - Ship & Offshore Engineering Dept.
  - Tokyo Shipyard
  - Aichi Works
  - Kure Shipyard
  - Yokohama Ship Repair Dept.
  - Aioi Ship Repair Dept.
  - Kagoshima Works
- Aero-Engine & Space Operations — T. Ishikawa (Gen. Mgr.), M. Ito (Deputy Gen. Mgr.), T. Miyo (Ditto)
  - Aero-Engine Div.
  - Civil Aero-Engine Div.
  - Space Development Div.
  - Land & Marine Gas Turbine Div.
  - Research & Engineering Div.
  - Manufacturing Div.
    - Mizuho Aero-Engine Plant
    - Tanashi Aero-Engine Plant
    - Kure Aero-Engine & Turbo Machinery Plant

ORGANIZATION CHART




Aichi Works
General Superintendent
Quality Control Dept.
Production Workshop
Production Control Group
Fabrication Shop
Assembly Shop
Erection Shop
Hull Fitting Shop
Machinery Fitting Shop
Trial Shop
Painting Shop
Production Control Dept.
Production Administration Group
Purchasing Group
Material Control Group
Power & Maintenance Group
Engineering Dept.
Engineering Administraction Group
Fitting & Coordination Group
Structure Group
Electrical & Control Group
Zone Fitting Group
Sales Business Dept.

Brochure omitted on the request of the shipyard.

ENCLOSURE (3)

- **Computer System Map (system structure/flow chart) for Shipbuilding**

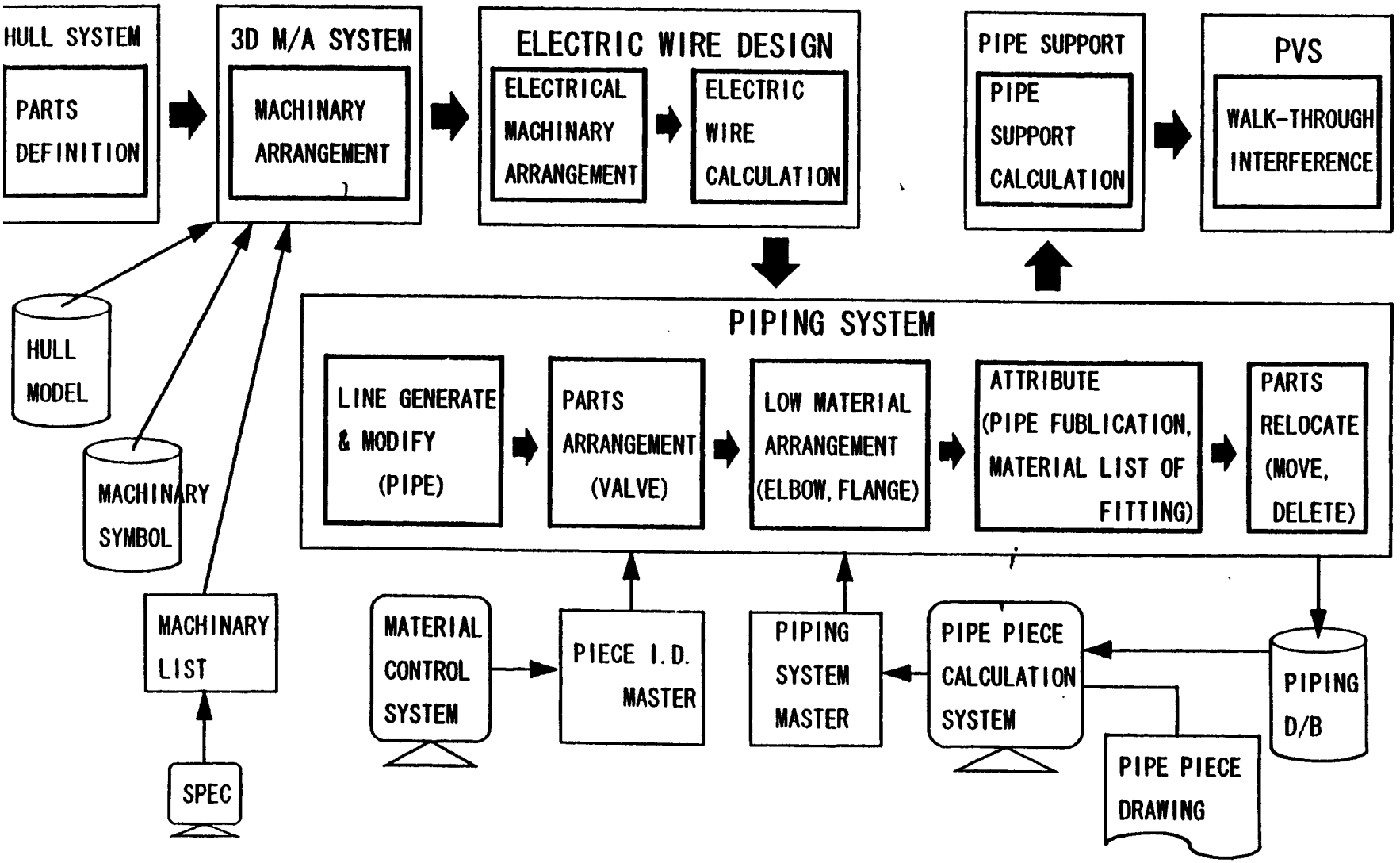
- **AJISAI Ship Design CAD System Demonstration Flow Chart**

AJISAI

H7. 11. 29

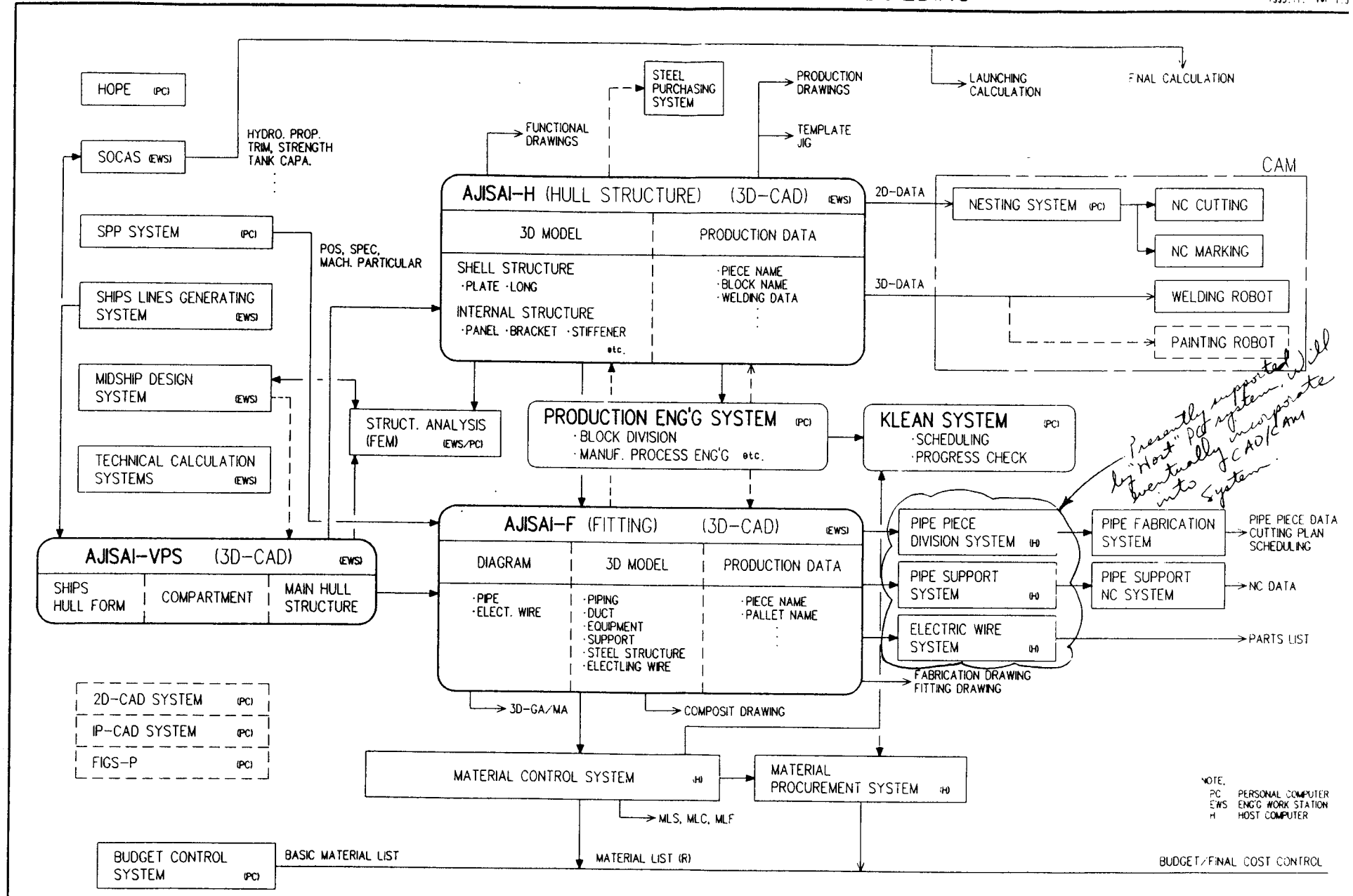
SHIP DESIGN CAD SYSTEM DEMONSTRATION

(HULL・MACHINARY・PIPE・ELECTRIC)



IHI

COMPUTER SYSTEM MAP FOR SHIPBUILDING



NSRP SP6 PROJECT 6-94-1

WORLD CLASS SHIPBUILDING STANDARDS

QUESTIONS AND RESPONSES FROM

IHI Co., Ltd. SHIPYARDS, JAPAN

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

TABLE OF CONTENTS

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

The following listing of standards is offered to provide the reader with the type of standard, country of origin and their associated abbreviations, some of which are addressed in this document. Refer to ASTM Standard Guide Listing - ASTM F1547-94, Relevant Standards and Publications for Commercial Shipbuilding, for additional listing of applicable standards.

CLASSIFICATION SOCIETIES

Lloyds Register of shipping (Lloyds) - Great Britain
American Bureau of Shipping (ABS) - United States
Det Norske Veritas (DNV) - Norway
Germaniser Lloyds - Germany
Bureau Veritas - France

REGULATORY AUTHORITIES

American Bureau of Shipping
United States Coast Guard
United States Public Health

EUROPEAN STANDARDS

[Under development]

INTERNATIONAL STANDARDS ORGANIZATION

International Standards Organization (ISO) -

NATIONAL STANDARDS

Deutsches Institute furNormung (DIN) - Germany
American National Standards Institute (ANSI)
British Standards Institute (BSI)
Japan Industry Standard (JIS)
Korea Industry Standard (KIS)

ASSOCIATION STANDARDS

Danske Vaerfters Standardiseringsudvalg (DVS) - Denmark

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
A1. IDENTIFICATION OF PREDOMINANT STANDARDS	
A1.1 Is an index of Standards maintained?	Yes
A1.2 What is the extent of International, Domestic & Local Shipyard Standards application?	JIS (Domestic) used as a first choice and supplemented to satisfy customer requirements and shipyard production/design needs.
A2. POPULATION STUDY OF SHIPYARD, TYPES OF COMMERCIAL VESSELS AND ENVIRONMENT EVALUATION QUESTIONS	
A2.1 What has led the shipyard to its current market segment?	World market demands and world shipbuilding capacity has basically set the stage. IHI capable of constructing any type of commercial vessel.
A2.2 What type of ships has the shipyard built over the last 25 years?	Refer to Attachment (1) - Number and type of ships built by IHI - 1970 to 1995
What are the annual tonnage trends?	Refer to Attachment (1) - Annual GT of Ship Construction by IHI - 1970 to 1995
What are the annual ship completions?	Refer to Attachment (1) - Number and type of ships built by IHI (Since 1970)
A2.3 Do you carry out ship construction and repair?	Yes, at separate yards. Aioi Shipyard (IHI AmTech) & Yokahama Shipbuilding (IHI Amtech).
What is the repair to new construction ratio?	80-85% new to 20-15% repair.
What is the ratio of Commercial to Navy repair work?	30-40 commercial and 70-60% navy
What is the extent of modularization on new construction and repair work?	Up to 700 tons for new construction, (using two 400 ton capacity cranes). As required and feasible for repair.
How is modularization applied and integrated on new construction?	above
What is the extent of pre-outfitting of blocks prior to erection?	93%
A2.4 How many ships are currently under construction?	12 ships, 1 LPG/FSO (Floating Storage and Offloading Facility)
What is the schedule for current and future business?	No Response
How well are schedules met?	They are met.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

How does standardization affect construction and schedules?	Enables use of learning curves. Permits accurate estimates for construction time periods, and etc..
A2.5 What is the size and composition of the current labor force?	Refer to Attachment (2)
What are the average annual total personnel numbers?	~2900 in IHI Shipbuilding Divisions
Hourly	1600
Salaried	830
sub contracted	450
How has the level and composition of personnel changed over the last 10 years?	Down from 16,000 people 15 years ago.
What has influenced composition of personnel the most?	Market forces.
What are the general experience levels of personnel at the yard?	High
What is the average employment years of personnel at the yard?	20-25 years
Hourly	No Response
Salaried	No Response
sub contracted	No Response
How has the experience level of personnel changed over the last 10 years?	IHI has been downsizing their shipyard divisions by relocating (majority) of people to other IHI divisions. Insignificant new hires under downsizing conditions. Resulting experience levels equal or greater than 20-25 years
A2.6 What do you believe is the market position for the worldwide shipbuilding industry?	Saturated. World increased demand for shipbuilding is 2-3% - 1/2% is seaborne trade; equivalent to 20 million tons. (~2 million tons/year is for new capacity and 18 tons/year is for replacement vessels)
A2.7 Who are this shipyards major competitors?	Korean shipyards
What is your share of the market segment?	4%
What are the current market risk areas?	No Response

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

What are the economic effects?	No Response
NSRP SP 6 PROJECT 6-94-1 QUESTIONS	**IHI SHIPYARDS' RESPONSE**
A3. SHIPYARD/CLASS SOCIETY STANDARDS AND POPULATION STUDY **These questions explore the standards bases that are available to and used in preference by the Shipyard and Classification Societies.**	
A3.1 With your current customer base, which Class Societies are you presently working with?	ABS, NKK?
What is your Class Society of choice?	No Response
To what extent do you use ISO standards?	No Response
To what extent do you augment Class Society requirements with yard standards (basic proportion only)?	
How do you accommodate different customers' needs with respect to Class Societies and Standards applications?	Customer driven, but generally at an increased cost. Not a big issue.
Do you use a Master set of standards and make minor alterations as necessary?	Yes. Minor changes as customer dictates (at a cost unless in original contract).
Are standards sets based on specific, and limited range of, Customers/Class Societies?	No Response
How are standards and standardization presented to the customer?	They are not.
How are standards and standardization incorporated in Ship Specifications?	By generic reference in the contract. (IHI does not provide their standards to the customer for review. They are an established world class shipyard and do not believe this is necessary.)
A3.2 How do you access other standards?	No Response
What is the extent and scope of the Shipyard library?	IHI has an extensive library. If the desired International, National or Association Standard is not available, IHI has agents worldwide that can obtain whatever is required.
What is the format of Shipyard Standards?	Refer to Attachment (3) for examples of IHI standards.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
Does a Shipyard Standards Manual exist and what does it contain?	Yes. All standards are maintained at Tokyo Shipyard office and distributed to the other shipyards upon revision or creation. Each shipyard is responsible for their own internal distribution.
A3.3 Does the Shipyard library have a standards equivalency cross eference system.	No.
A3.4 To what extent are specific equipments and other standards pre-approved for use?	
Are standards pre-approved?	No. Past practice application of standards has been approved by Class Societies and IHI does not anticipate any problems using their standards in the future.
By Regulatory Authorities?	N/A
By Class Societies?	N/A
Are standards contract specific?	Where required by the customer.
A3.5 How do you negotiate requirements with the Customer?	
Who negotiates the standard?	If required - the cognizant technical persons or teams. Deviations from existing standards incur additional costs.
Contracts Group?	No
How does the Standards Group integrate with the negotiation process?	A specific Standards Group does not exist at IHI.
A4. ORGANIZATION AND BENEFITS The following questions concern the existence of the standards group and are based on a review of the shipyard organization.	
A4.1 Why is the Standards Group/Committee positioned in the organization the way it is?	To ensure best possible technical standards, IHI assigns cognizant people from the various technical disciplines to develop and maintain all standards.
Who does the Standards Group/Committees report to?	Individual discipline committees report to their discipline chairman, who is the section or department manager. All Standards committees are under the authority of the Ship and Offshore Engineering Department Manager or the QA Department Manager.
Who reports to the Standards Group/Committee?	See Attachment (A), Standards Management Practices, and Standards Approval Matrix, page 6 of Enclosure (1) Trip Notes
Who are the Standards Group/Committee primary customers?	Engineering

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
A4.2 When was the Standards Group/Committees formed and why.	
How did the Standards Group/Committees develop and what is the group's history?	10-15 years ago, the standards development and maintenance was changed from a Standards Group to a multiple committee organization, in an effort to reduce manpower through increased efficiencies.
Where is the Standards Group physically located?	Committees and Chairmen are located throughout IHI shipyards as a function of assigned responsibility.
What is the charter of the Standards Group/Committees?	To review standards in accordance with ISO 9001 on a set frequency of 3, 4 or 5 years or as feedback requires. Refer to Attachment (A), Standards Management Practices.
What is the short and long term goal of the Standards Group/Committees?	IHI is working towards putting their standards into an electronic data base at some point in the future to facilitate maintenance. No set schedule was identified.
A4.3 What are the internal responsibilities of the Standards Group/Committees?	Refer to Attachment (A), Standards Management Practices.
A4.4 What is the external awareness of the Standards Group/Committees to the world class standards?	IHI considers their standards to be world class.
Meeting standards?	They believe they already meet world class standards and adjust those that fall short of requirements.
Maintaining standards?	Well maintained.
Developing standards?	On going.
What is the Standards Group accessibility to National and International standards?	IHI Shipyard has access to IHI Corporation Technical Library in Tokyo, where various National and International shipbuilding standards are available. Individual shipyards also maintain some level of standards library. When specific standards are not available, they are obtained.
A4.5 What is the structure of the Standards Group/Committees?	
What are the personnel capabilities, skills and educational levels?	Highly skilled people with 10-20 years experience in the discipline. All members are selected by the section or department manager
What is the cycle of personnel to and from the Standards Group?	No set cycle - manager's discretion.
What are the specializations of the Standards Group/Committees personnel?	Whatever the discipline is.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
What is the supervisory level required for the Standards Group/Committees?	Section Manager or Department Manager. Also, Refer to Standards Approval Matrix, page 6 of Enclosure (1) Trip Notes
What supplementary training is offered/required for the Standards Group?	Junior personnel are assigned on a training basis on their respective discipline's committee. As of late, this is a preferred practice - not always economically feasible.
What facilities are available to the Standards Group/Committee to expedite standards work (e.g., PC, Networks)?	Paper base at present. IHI will implement on PC data base in the future. (IHI will work to have all engineers/designers provided with a CAD/PC.)
A4.6 How are shipyard standards developed?	Engineering need and Production feedback - by cognizant discipline committee.
What is the standards development process?	Engineering need and Production feedback establish the need for creation or revision of standards. The cognizant committee will develop and process the standard(s) through approval.
How are the standards requirements evaluated?	Refer to Standards Approval Matrix, page 6 of Enclosure (1) Trip Notes
What is the approval process for standards?	Refer to Standards Approval Matrix, page 6 of Enclosure (1) Trip Notes
How is shipyard feedback on standards requirements achieved?	Sent to the Section Manager or Department Manager/Committee Chairmen.
How is vendor feedback on standards requirements achieved?	IHI Standards have been in existence for some time. This is not an issue.
A4.7 How is the Standards Group/Committees perceived in the shipyard?	High priority, very important - with usual shipyard impact on priorities.
By upper management?	Well developed and structured. Philosophy embodied in everyday work processes. Endorsed by senior management. Required to be a world class shipyard.
By internal and external customers	same as above
What is the qualitative value of the Standards Group/Committees?	high
A5. STANDARDS DATA BASES	
A5.1 Are Class Society requirements and standards held in a data base?	Yes - paper base.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
A5.2 What is the size and type of the data base?	~5500 - reproducible drawings
A5.3 How is the data maintained and updated.	Manually
A5.4 Are National and International Standards held in the data base?	No
A6. PAPER BASED STANDARDS CONFIGURATION	
A6.1 What is the mechanism for distribution?	IHI Tokyo distributes to all IHI Shipyards. Each shipyard is responsible for their own internal distribution.
A6.2 What is the format of Standards and how are they processed?	Refer to Attachment (3)
A6.3 How are the standards tied to other engineering or production documents?	Some standards are referenced on working drawings. Others are commonly used in shop and ship processes and do not need any special reference.
Engineering Drawings?	above
Ship Specifications?	Not included other than generic reference to "builders Standards". Not for approval.
Production Plans?	above
Check Lists?	No Response
A7. CAD BASED STANDARDS CONFIGURATION	
A7.1 What is the architecture of standards in cad?	Working towards March 1996 for incorporation of all standards in CAD data base necessary to support, followed with ~ 5 months of confirmation testing to enable on line 100% by august 1996.
A7.2 How are standards integrated with CAD based Engineering?	In process of being incorporated into CAD. Explanation provided in formal Trip Report letter - Tab 1. Also, refer to Enclosure (3) for additional CAD systems flow charts.
Catalog data base	above
Catalog data base with vendor input and format?	no
Interface between Engineering CAD and standards data base?	A7.1
A7.3 How are standards presented to the CAD operator?	

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
By default?	Yes. Standard default options presented with ability for manual input override.
By selection from accessible data base?	Yes. Selected by menu.
By decision tree?	not apparent
A7.4 How is the engineering bill of material used downstream?	
Material requirements planing (MRP or MAC-PAC)?	yes
Network system?	yes
Manual system?	no
A7.5 How are standards distributed to Computer Aided Manufacturing?	CAM not currently linked to Engineering CAD.
A7.6 What standards are best incorporated into CAD/CAM?	Parametric based standards.
What are the priorities?	Working towards March 1996 for completion of prototype completion with ~ 5 months of confirmation testing to enable on line 100% by august 1996. Explanation provided in formal Trip Report letter - Tab 1. Also, refer to Enclosure (3) for additional CAD systems flow charts.
Are those standards stable or dynamic?	stable
Are the standards restrictive?	No Response

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
B1. ORGANIZATION IDENTIFICATION	
B1.1 What is the approximate ratio of computers to engineers?	20%
B1.2 Are there any subsidiary yards in the company?	IHI has 3 new construction shipyards and 2 repair yards. Refer to enclosure (2) for additional information on the 3 new construction shipyards and IHI profile.
B1.3 What is the level of Engineering done in house vs. subcontracted?	All engineering done in house.
B1.4 What types of engineering are typically subcontracted?	None - detail engineering and design done at the constructing shipyard.
B1.5 What is the awareness and/or familiarity of contract level designers and engineers in standards details?	Very good at all levels.
B1.6 What is awareness/familiarity of production personnel in standards details?	Very good.
B1.7 How are make/buy decisions made? Why might they be changed? How are they changed?	Cost analysis and past practice.
B2. STANDARDS INTEGRATION	
B2.1 How are ship specifications categorized/indexed? Are Ship Work Breakdown Schedules (SWBS) used?	Internal shipyard standard used to define SWBS.
B2.2 How are system design requirements provided to engineers?	Contract Specification.
B2.3 Who is responsible for selection of standards on each contract?	Existing standards are applied as required by design needs by all engineers and designers.
B2.4 How are restrictions in use of standards identified?	No Response

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
B2.5 What type of Manufacturing Resource Planning (MRP) process do you use? This process identifies when quantities of each type of item required to build the ship is required in the shipyard.	Windows based "Klean System". Refer to Enclosure (3) to DDA Trip Report, file ihitrip.doc dtd 12/22/95.
B2.6 How do engineers find standards?	No Response
B2.7 How do engineers/designers identify the components they want to use from the standards on their drawings?	By using a parts library - developed in a PC base and loaded into CAD/CAM - selection is made from a menu format in CAD.
B2.8 How many contract unique standards does the shipyard have?	Minimal.
B2.9 How are changes to the standards handled?	No response.
B2.10 How are standards imposed on sub-contractors?	Provided to them in IHI purchase order.
B2.11 How are planning issues handled for standard vs. non-standard parts?	No response.
B2.12 How are non-standard items identified to replace standard ones?	No response.
B2.13 How is non-conforming material handled? What amount of non-conforming material is delivered to the yard? How is this prevented?	Claims are processed against vendors delivering non-conforming material; however, these are not always paid. Japanese vendors are very good whereas, European vendors are less concerned.
B2.14 What is the level of detail in a composite drawing? How does it identify system components? How does the composite compare to the diagram?	To the pipe spool piece identification only level - no manufacturing details. Diagram comparison to composite not addressed.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
B2.12 How well integrated are standard vendors (CAD, purchase specifications, vendor furnished information)?	All vendor design standards for their equipment are provided and entered into the CAD/CAM data base.
B3. INTERNAL APPROVAL PROCESSES FOR STANDARDS APPLICATIONS:	
B3.1 Is there a formal process for maintenance of standards?	Individual Departments Responsible.
B4. PREDOMINANT STANDARDS USED BY REGULATORY AND CLASSIFICATION BODIES:	
B4,1 How do our definitions of standard types compare with yours?	In basic agreement.
B4.2 Do you have other types of standards that you regularly use?	Yes. SPAIS - Shipbuilding Process and Inspection Standard, and QISSP - Quality and Inspection Standard for Ship Painting
B4.3 Do you have standard vendors? If so, who are they?	Yes. Standard vendors list is provided to all customers.
B5. REGULATORY AUTHORITY AND CLASSIFICATION SOCIETY APPROVAL PROCESSES:	
B5.1 Which regulatory/classification bodies require approval of the standards?	None
B5.2 How is regulatory/ classification body approval of standards handled?	Cognizant technical person/committee, per contract by submitted drawings.
B5.3 Which standards must be approved by these bodies?	No Response
B5.4 How do you view ISO 9000 certification?	Very important. Working to achieve. Two yards certified; one not.
B6. USE OF SHIPYARD VERSUS STANDARDS ORGANIZATION STANDARDS:	
B6.1 What are most of the shipyard standards based on? JIS, ISO, ...?	JIS
B6.2 How do the shipyard standards compare to ISO/JIS?	JIS based, augmented by IHI standards.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	IHI SHIPYARDS' RESPONSE
B7. FORMAT OF SHIPYARD STANDARDS:	
B7.1 What are the perceived benefits of standards?	No Response
B7.2 How are preferred standards identified?	All standards are preferred. Customers may request (and pay for) different standards.
B7.3 How do you identify the following requirements in your standards?	
Engineering selection criteria?	SOT (Engineering Standards) - Refer to Attachment (A)
Identification on engineering products	P/N's
Fabrication information for suppliers?	on standard
Installation information for production personnel?	on standard
B7.4 What are come recent changes in your standards program?	No Response
B8. EXAMPLES OF TYPICAL SHIPYARD STANDARDS:	
B8.1 What are your standards for the following applications?	
Pipe hangers	Refer to Attachment (3)
Ladders	Refer to Attachment (3)
Wireways	Refer to Attachment (3)
B8.2 Are these parts built by the yard or by sub-contractors?	Not specifically addressed. A great deal of these type item are generally subcontracted.
B8.3 Are subcontractor's parts specified or does subcontractor build to shipyard requirements?	both
B8.4 What primary factors influence these designs?	
Internal shipyard processes?	Primary - based on lowest fabrication and install costs.

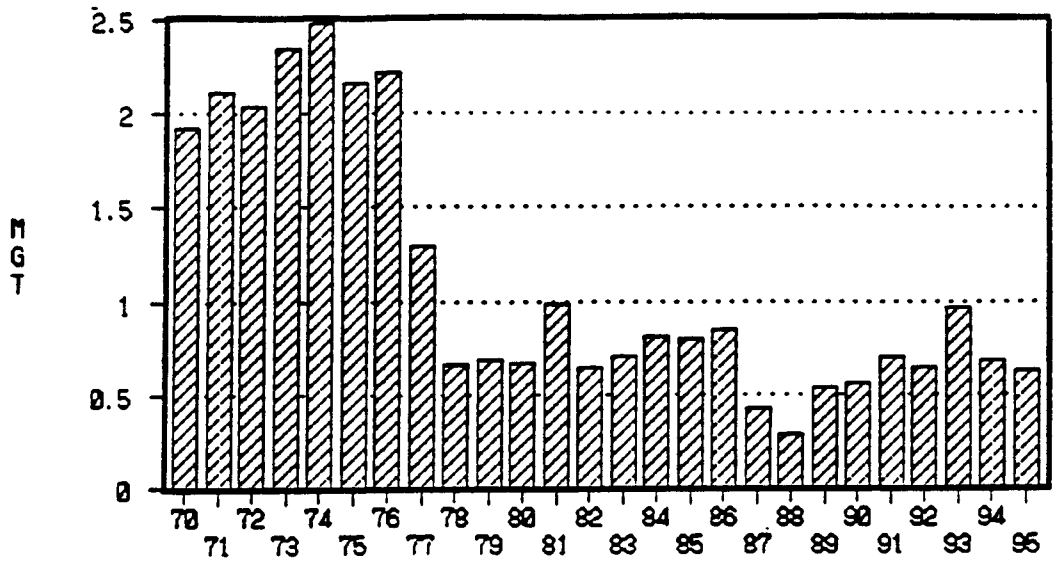
NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM IHI SHIPYARDS, TOKYO, NAGOYA AND KURE, JAPAN

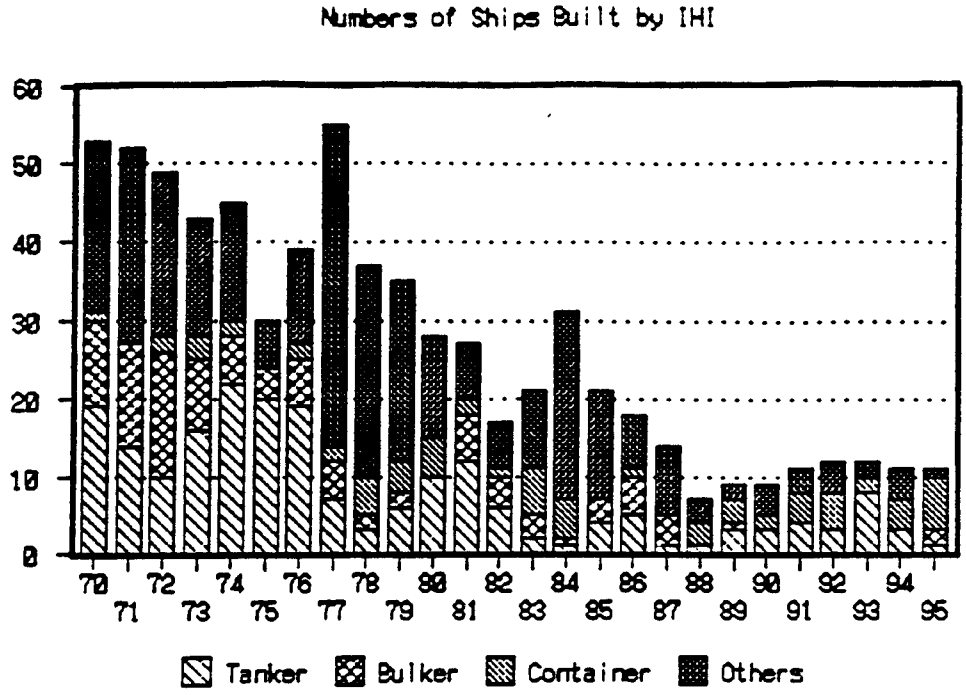
National/International Organizations?	**No Response**
Classification Societies?	**No Response**

ATTACHMENT (1)

- **IHI New Construction Ship Types, Quantities and Gross Tonnage, 1970 - 1995**

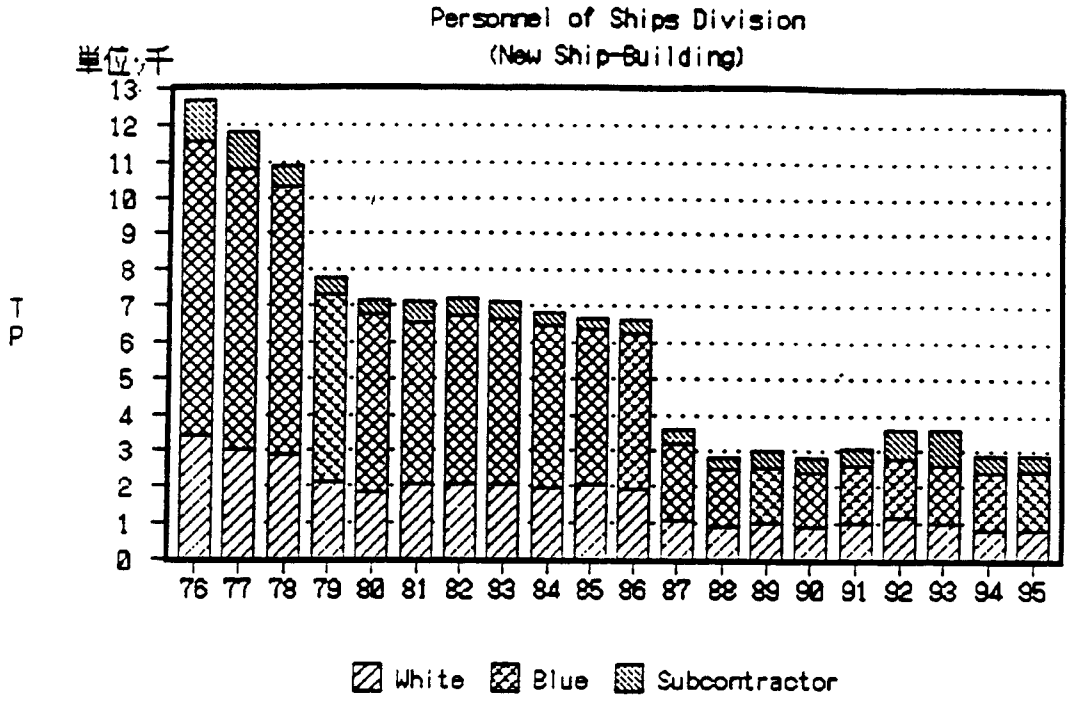
Ships Built by IHI (GT)




Numbers of Ships Built by IHI
60
50
40
30
20
10
0
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
Tanker
Bulker
Container
Others

ATTACHMENT (2)

- **IHI Labor Force Size and Categories, 1976 - 1995**

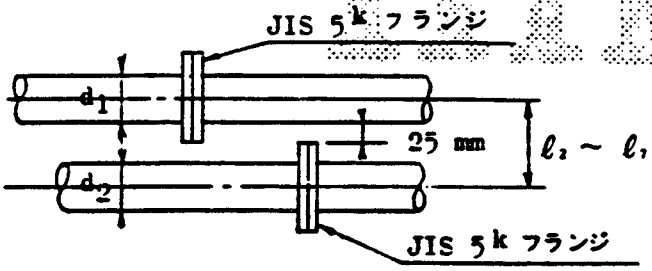

Personnel of Ships Division
(New Ship-Building)
単位:千
T
P
13
12
11
10
9
8
7
6
5
4
3
2
1
0
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95
White
Blue
Subcontractor

ATTACHMENT (3)

- **Examples of IHI Standards for Pipe Hangers, Vertical Ladders and Cableways**

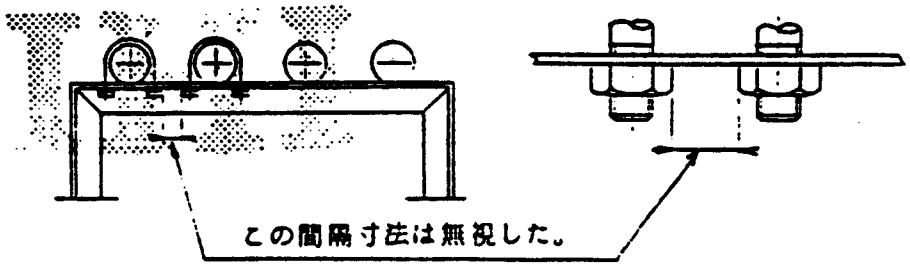
付表－9－　JIS 5K フランジの管間隔寸法表

（バルブ無し）



フランジ呼び d1 / d2	管間隔 ℓ2 ～ ℓ1 寸法表 (mm)																		
	15	25	40	50	65	80	100	125	150	200	250	300	250	400	450	500	550	600	
80	15	76																	
95	25	84	90																
120	40	96	102	110															
130	50	101	107	115	120														
155	65	114	120	128	133	141													
180	80	126	132	140	145	153	160												
200	100	136	142	150	155	163	172	182											
235	125	154	160	168	173	181	188	200	215										
265	150	169	175	183	188	196	203	215	228	241									
320	200	196	202	210	215	224	230	242	255	268	293								
385	250	229	235	243	248	256	263	275	288	301	326	359							
430	300	251	262	265	271	279	285	298	310	323	349	377	400						
480	350	276	282	290	296	304	310	323	335	348	374	399	425	443					
540	400	306	312	320	326	334	340	353	365	378	404	429	455	473	499				
605	450	339	345	352	358	366	373	385	398	411	437	462	487	506	531	556			
655	500	364	370	377	383	391	398	410	423	436	462	489	512	531	556	582	607		
720	550	396	402	410	416	424	430	443	455	468	494	519	545	563	589	614	639	665	
770	600	421	427	435	441	449	455	468	480	493	519	544	570	588	614	639	664	690	715

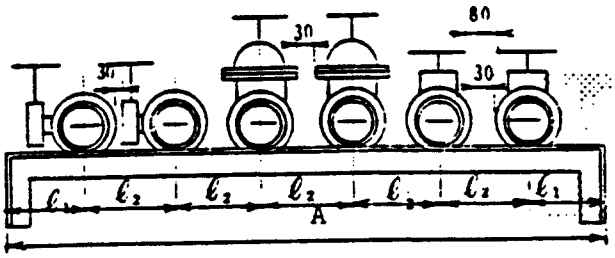
㊟ 上記寸法は下記は考慮されていないので注意のこと。



部長	課長

改正回数	0	1	2	3	4	5
年月日						
来歴						

付表－12 弁並列間隔 ℓ_2 および ℓ_1 寸法表



注：ℓ_2 はフランジ，玉形弁，仕切弁，バタフライ弁を左図の条件に取付けるのに必要な弁間隔で数値は最小寸法を示す。

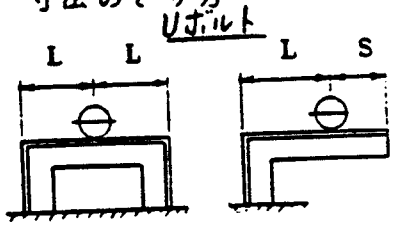
呼径	ℓ_1	ℓ_2	A 1連	2連	3連	4連	5連	6連	7連	弁の形式
15	66	160	132	292	452	612	772	932	1092	JIS10K 玉形弁
25	79	205	158	363	568	773	978	1183	1388	
40	86	220	172	392	612	832	1052	1272	1492	
50	92	240	184	424	664	904	1144	1384	1624	
65	101	280	202	482	762	1042	1322	1602	1882	
80	106	280	212	492	772	1052	1332	1612	1892	
100	136	330	272	602	932	1262	1592	1922	2252	
125	149	360	298	658	1018	1378	1738	2098	2458	
150	162	395	324	719	1114	1509	1904	2299	2694	
200	196	435	392	827	1262	1697	2132	2567	3002	
250	221	540	442	982	1522	2062	2602	3142		
300	254	625	508	1133	1758	2383	3008			
350	273	685	546	1231	1916	2601	3286			JIS10K 仕切弁
400	299	780	598	1378	2158	2938				
450	337	870	674	1544	2414					
500	368	975	726	1701	2676					
550	389	1080	778	1858	2938					
600	430	1185	860	2045	3230					
650	457	2013	914	2927	4940					バタフライ弁
700	483	2133	966	3099	5232					
750	509	2278	1018	3296	5574					
800	547	2373	1094	3467	5840					
850	570		1140							
900	598		1196							

部長	課長

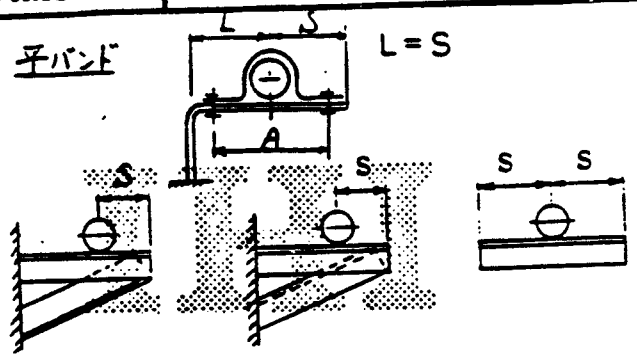
改正回数	0	1	2	3	4	5
年月日						
来歴						

付表－8 自由端長さと寸法表

1) 寸法のとり方



平バンド



2) 寸法一覧表

呼径	Uボルト U1～U6 L	Uボルト U1～U6 S	平バンド A2, C2 L&S	A2, C2 A	V1 L&S	V1 A	B0 (5k) L&S	B0 (5k) A	B1 (10k) L&S	B1 (10k) A	B2 (16k) L&S	B2 (16k) A	A1 L&S	A1 A	備考
15	50	30	45	60	54	78	73	120	80	134	80	134	54	78	
20	54	45													
25	55	45	50	69	61	90	80	134	95	164	95	164	61	90	
40	65	50	57	84	69	106	98	166	108	186	108	186	69	106	
50	70	55	62	93	75	119	103	176	115	200	115	200	75	119	
65	80	65			83	135	126	212	136	232	136	232	83	135	
80	90	70			90	148	139	238	141	242	149	258	90	148	
100	115	90			116	193	165	280	170	290	177	304	116	193	
125	125	105			130	219	182	314	190	330	200	350	130	219	
150	140	115					197	344	205	360	217	384			
200	180	145					234	408	239	418	249	438			
250	205	170					266	472	274	488	289	518			
300	245	210					305	540	312	554	330	590			
350	265	230					330	590	335	600					
400	290	255					360	650	370	670					
450	330	295													
500	355	325													
550	380	360													
600	415	385													
650	440	420													
700	465	445													
750	490	470													
800	535	505													
850	560	530													
900	585	550													

U5, U6は銅管用

C_2：銅管用　A_2：アルプラ管用　塩ビ管用

鋼 JIS 5k フランジ用　鋼 JIS 10k フランジ用　鋼 JIS 16k フランジ用　アルミブラス管用

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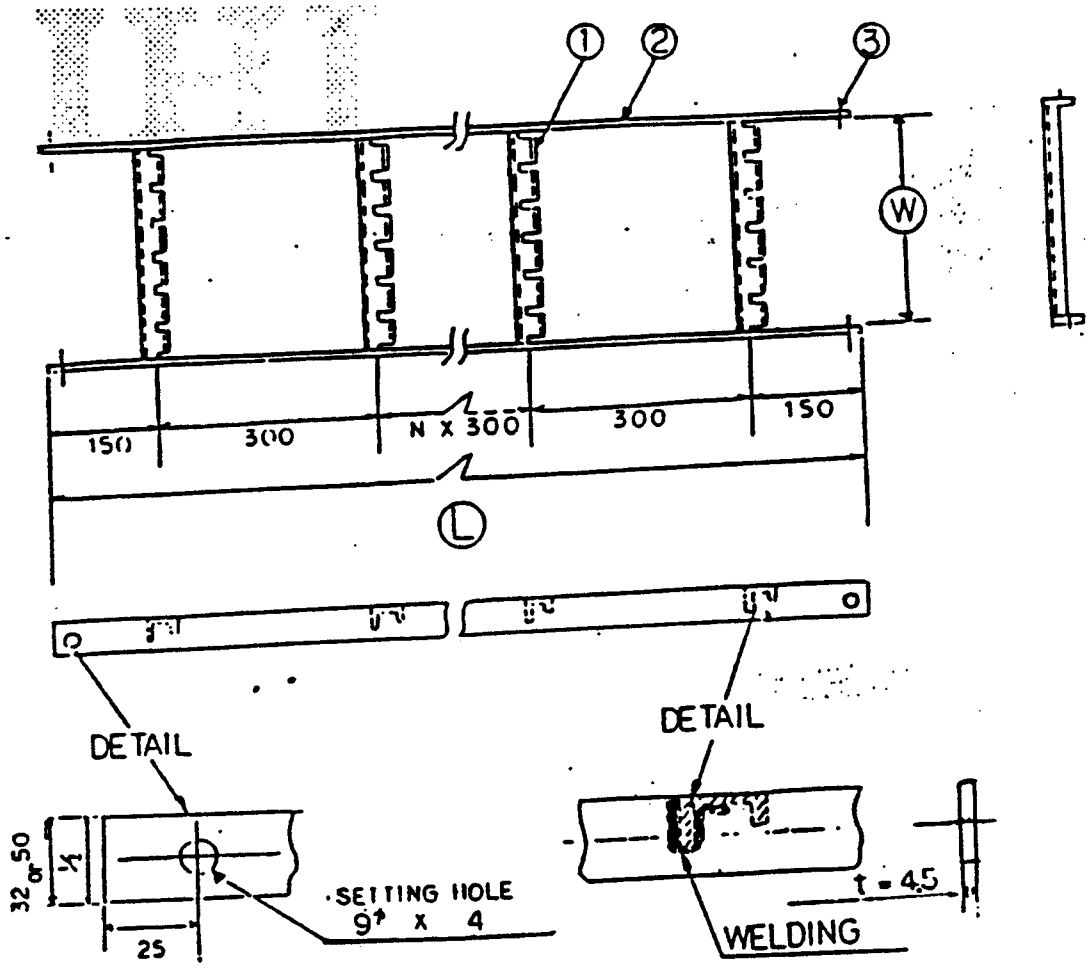
改正回数	0	1	2	3	4	5
年月日						
摘要						

IS	NC形電線ラック CABLE RACK TYPE - NC.	SO-5721201	5



WIDTH (MARK: Ⓦ) AND LENGTH (MARK: Ⓛ) SHALL BE
REFER TO THE ATTACHED SHEET PAGE 4.

M.K	NAME	NO.	MATERIAL	REMARKS
1	CABLE HANGER		STEEL PLATE	≤B 15~30 t=2.3 ≤B 40~70 t=3.2
2	REINFORCE CABLE HANGER		STEEL PLATE	≤B 15~30 = 45×32FB ≤B 40~70 = 45×50FB
3	SETTIG HOLE			9↑
4				
5				
6				
7				
8				
9				
10				

SO-5721161参照

部長	課長

改正回数	0	1	2	3	4	5
年月日						
来歴						

15	CABLE RACK TYPE - NC	SO-5721261	15

IHI

TYPE	WIDTH (W) mm	LENGTH (L) mm	NO. OF HANGER	MASS kg	RUNNER BAR	CODE No.
15A	150	600	2	1.65		5726261 11
〃 B	150	900	3	2.50	FB	〃 12
〃 C	150	1,200	4	3.30	4.5 X	〃 13
〃 E	150	1,800	6	5.00	32	〃 15
20A	200	600	2	1.75		〃 21
〃 B	200	900	3	2.60		〃 22
〃 C	200	1,200	4	3.45		〃 23
〃 E	200	1,800	6	5.20		〃 25
30A	300	600	2	1.95		〃 41
〃 B	300	900	3	2.90		〃 42
〃 C	300	1,200	4	3.85		〃 43
〃 E	300	1,800	6	5.75		〃 45
40A	400	600	2	3.45		〃 61
〃 B	400	900	3	5.15		〃 62
〃 C	400	1,200	4	6.90	FB	〃 63
〃 E	400	1,800	6	10.30	4.5 X 50	〃 65
50A	500	600	2	3.75		〃 81
〃 B	500	900	3	5.65		〃 82
〃 C	500	1,200	4	7.50		〃 83
〃 E	500	1,800	6	11.25		〃 85
60A	600	600	2	4.25		〃 91
〃 B	600	900	3	6.40		〃 92
〃 C	600	1,200	4	8.50		〃 93
〃 E	600	1,800	6	12.75		〃 95
70A	700	600	2	4.62		〃 01
〃 B	700	900	3	6.90		〃 02
〃 C	700	1,200	4	9.20		〃 03
〃 E	700	1,800	6	13.80		〃 05

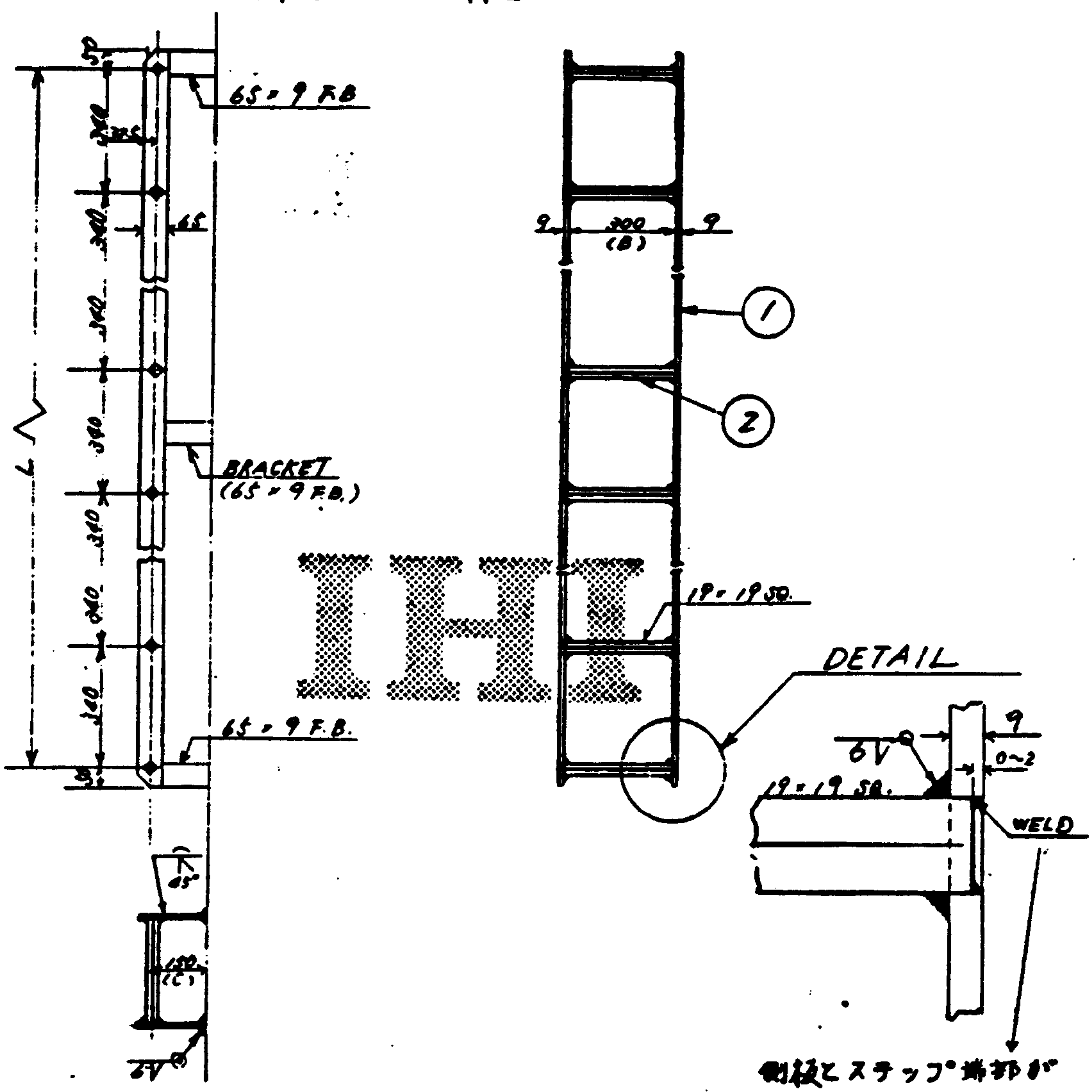
NC

IHI

部長	
課長	

改正回数	0	1	2	3	4	5
年月日						
承認						

VFS − 5 形
VFS − 5 TYPE



側板とステップ端部が面一とならないときは溶接にて全面埋めること。

新溶接記号適用

MARK	ITEM	MATERIAL	必要数 (1 SET)	WT.	REMARKS
2	STEP	STEEL BAR SS 41	必要数		
1	SIDE FRAME	STEEL PLATE SS 41	2		

改正回数	0			4	5
年 月 日	43 12 10	44-	47		

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http://www.USAShipbuilding.com/